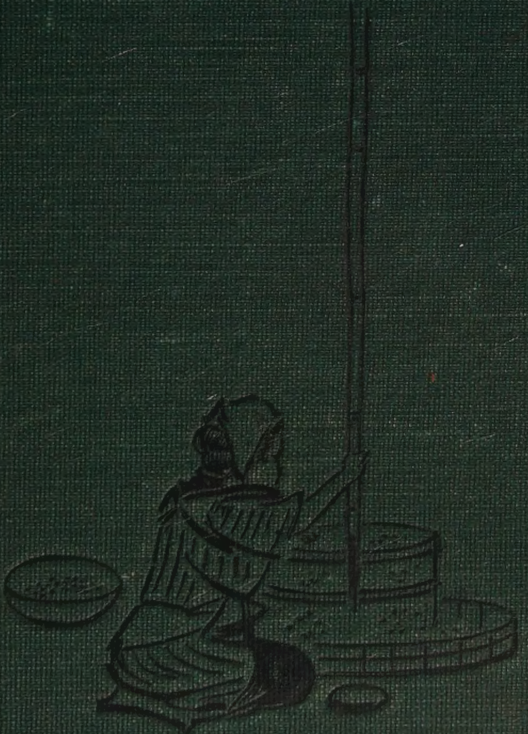
FOOD

WHAT IT IS AND DOES



EDITH GREER

20-03 Cereals.

Hazel Kleeberger
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SCHOOL · HOME · COMMUNITY SERIES

FOOD

WHAT IT IS AND DOES

BY

EDITH GREER

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PREFACE

Production of food and food-preparation are among the oldest occupations of human life. They are still most essential to human well-being. Cultivation and cooking of food have come down the ages into complex activities highly specialized and associated with concentrated commercial interests. Together these are coming under the direction of science and the regulation of the community.

Occupation with the needs created by living, is a common human pursuit, practiced with or without purpose or plan. Any continuation of life necessitates work. Advancing life requires intelligent work that includes the study of how to live constructively. That this may be, the study of food in school is now generally advised by all prepared to see its bearing upon both wholesome life and efficient work, and also how the understanding coöperation of humanity is needed in supplying and selecting what is of use for growth and health.

Civilization, in whatever stage it is at the time, is the environment into which each generation comes. But what the environment becomes in its supplies and practices is determined by humanity as it lives. Experience served as a guide to action until Science was born. Together Experience and Science inform humanity and can be forming to its environment, upon which its physical nurture depends.

The learner responds to the *active* aspects of learning with understanding. Personal experience in activity carries one not only into seeing facts but also into knowing their meaning. Cookery in its actual practice in choosing, combining, preparing food makes food-knowledge center in nourishment, in which its real significance lies.

But where cookery has not become a school course, while that subject is being ushered in — speed the day — or is being pursued

only in its mechanical aspects, a study of food — diet — nutrition is needed. Such a school need for girls and also boys is met in this presentation of *Food — What it is and does.*

No community is longer wholly indifferent to youth's entering upon its mature functions and responsibilities, devoid of knowledge of what sustains and makes possible intelligent maintenance of abiding health and enduring energy. Even habits that secure healthful functioning of the body need the supplement of an intelligent, interested attitude toward information that has forming power for race-growth.

EDITH GREER

NEW YORK

CONTENTS IN GENERAL

ILLUSTRATIONS

Food Maps and Statistics
Food Charts and Tables
Diagrams and Interpretations

Meat Cuts and Carving
Table-Laying and Equipment

New England Hearth
Norwegian Bread-making
Italian Kitchen and Well-head

Index records Specific Cuts
under Illustrations

Cocoa *Date* *Papaw* *Banana*

Plant life and Plant foods; Animal life and Animal foods; Food-Science
Living — Industry — Commerce; Home and Community Occupations

Certain needs are common to all physical life. It always requires *air*, *water*, and *food of some kind*. In general, however, the specific foods desirable for different persons are as different as are the persons and their lives

Light on Life lightens labor in living
through Strength, Progress, Growth

PLANT LIFE AND PLANT FOODS

CYCLE OF NATURE

By courtesy of Bowdoin College

A COLONIAL FIREPLACE

FOOD—WHAT IT IS AND DOES

MARKETS **HUMAN FOODS**

Food Markets of the world show the foods of all climates, seasons, lands. Grain foods, vegetables, fruits, meats, dairy products are all seen and are all different. Yet they all contain most of the food substances needed to nourish humankind, but in such different proportions and combinations as to make great variety in Human Foods.

City markets everywhere are much alike in what they have, and they have most foods known to humanity. In town, village, hamlet is found only what is produced in the locality. It is these rather than the cosmopolitan markets that show the characteristic foods of the land. It is upon such foods that the majority of the inhabitants depend for nourishment, that is, must live, grow, and do their work.

Rural life may limit further what comes from elsewhere, but it usually can be made rarely rich in what may be freshly raised at hand. With its abundance of fresh air and often fresh spring water the country provides for health-giving physical living that cannot be so fully insured under any other conditions.

Human foods support the life of humankind. They differ from the foods needed by both animals and plants but include both plants and animals themselves. Whatever humanity can digest, that is, can make over into body-tissue or otherwise use to aid in its living and working, is a human food. But all human foods are not equally desirable. Only those foods are valuable which do for the body what food needs to do to give the body health, energy, strength, endurance, and which do not do anything less helpful. Which foods these are varies somewhat with life-conditions.

Of what plants and animals make human foods and how they do this is considered later. The result of their food-manufacture is that human food is both vegetable and animal. Both serve in some respects the same purpose in the body, while in others their use is different. Either vegetable or animal food would sustain life, but both together do so much better than either could. Vegetable food would do better alone than animal. Not a few persons do live upon it entirely. There are, however, reasons that make food-scientists doubt the advisability of an exclusively vegetable diet. But Science now advises that somewhat more than one half (at least .56) of the food of humankind be vegetable.

Plant food supplies most of the energy and endurance of the body in starch, sugar, and vegetable-oil foods ; also much of the body-heat, the food-bulk required for digestive activity, the salts needed for body-regulation, and the water used in living processes and food-utilization. Some vegetable food can also build up body-tissue as it needs repair or material for growth.

Vegetables, fruits, and seeds are of plant production. What these are like and where they come from, how they come, are prepared and used, are the food-facts that show what the food-supply brings to humankind as its vegetable food.

Looking back of the food as served is seen the life of the plant itself, also the work of those that bring it to humankind as a human food that will nourish when eaten. Seeking such facts and seeing them as factors controlling the sustenance of humanity is the purpose of studying Food — What it is and does.

What vegetable food is used in human living is learned from markets that show what foods are available and from science that finds what foods can be produced and supplied, also what kinds of food are needed.

COMPOSITION (STARCHY) VEGETABLES

Plant food known generally as vegetables, fruits, grains, nuts, consists of various parts of the plant. The root, stem, stalk, leaves, flower, fruit, seeds all serve as human foods, but not all these parts of the same plant. Each vegetable food is the edible part of the plant from which it comes. Beets are roots; celery is stem; cabbage, leaves; cauliflower, flowers; tomato, fruit; cocoa, seed. Different parts of some plants are edible at different seasons, as bean pods when young and beans when older.

Vegetables containing much starch are not edible raw, because starch cannot be digested uncooked; such are potatoes. Vegetables containing a large percentage of starch are called starchy vegetables (see pp. 6, 9) to indicate this fact and designate in general what their use will be as a human food, for it is only their *use in the body which makes them of importance as foods.* Starchy vegetables keep well. They are therefore suitable for out-of-season use.

Starch develops in plants as they mature, as fat does in animals as they grow old. Starch eaten in excess of the daily need stores fat in the body as body-fat. Cooked starchy foods supply the body with energy that endures and body-heat.

Other constituents beside starch are present, too, in so-called starchy foods. These are water, mineral matter, often some sugar, fat in the form of oil, and a very complex substance called protein that always contains some nitrogen compounds. Protein is present in all living matter.

This constituent (protein) enables food to build up body-tissue as growth requires and living necessitates. Mineral matter serves in body-building too (the skeleton is largely mineral matter) and also aids digestion in various ways. Water does the latter too. Sugar and fat furnish heat-energy that is used more quickly than that supplied by starch.

One group of the starchy vegetables contains more protein than others. These are known as legumes. They are peas, beans, lentils. They have a power all vegetables do not share. Other plants take the nitrogen compounds they make into protein from the soil. Legumes have on their roots small tubercles or nodules in which there are bacteria that enable them to take free nitrogen directly from the atmosphere and store it in such plants for food use. Peanuts are also leguminous.

Clover though not a human food is a leguminous plant, therefore has this power. By taking the free nitrogen of the air thus and making it into plant protein such plants can return the nitrogen in themselves to the soil for the plants that cannot take it from the air. This has been one method of enriching the soil.

Tubercles on clover root

There is in many vegetables much woody fiber forming coverings and inner structure of the plant. This fiber is called cellulose. Cellulose, starch, sugar are all together termed carbohydrates in Food Science, because the elements of which they are composed are alike. These differ in their quantities and arrangement, and thus make the different carbohydrates — starch, sugar, cellulose. In general, carbohydrates supply heat-energy. Sugar is the carbohydrate most readily assimilated by the human system. Starch needs preparation before it can be utilized. Cellulose is only slightly digested, if at all, and then only from very young plants. There is little actual cellulose in human foods as eaten.

" Green vegetables " is a term used to signify plant foods eaten fresh, usually raw and generally young. Industry is now canning these extensively. Transportation is carrying them from all climates to all cities. Both these practices result in some storing of such foods. The renewal of common interest in food-production is resulting in more distributed food-growth, hence less preservation of food and a fresher food-supply. This is most desirable for all food, but especially important for foods that have as one of their functions (that is, what they do) bringing refreshment through their own freshness.

Greenness suggests the freshness of newness. Green vegetation does this for life at large. Spring renews evidences of life. Summer verdure refreshes life. New plant foods renew diet. Green vegetable foods keep a diet fresh.

Though all such foods are not used uncooked, many usually are; as lettuce, celery, radishes. They are most propitiously so used. Some are served simply as relishes, but it is as salads that their use is to be developed. Italy, the land of wealth in plant production, gives salads as a form of food-preparation of fresh green plants with olive oil. This is becoming the general food practice here and elsewhere. Encourage it.

These so-called green vegetables (see pp. 6, 8) contain much water, some cellulose, a relatively large percentage of mineral matter, and usually a distinctive flavor. Their value in human nutrition is their aid to the general maintenance of body-processes. They bring freshness, salts needed, and water. Cellulose (woody fiber) that is present in them can so stimulate the alimentary tract as to enable it to free itself of waste products; though were cellulose itself retained in the body in excess it would endanger intestinal fermentations that prevent proper digestion of any food and so undermine health.

There is no distinct separation between the different groups of vegetables called starchy and green. One group passes gradually into the other, sometimes a plant is used while young as green and as starchy when old, as beans. It is only the extremes of both that show marked differences, as do potatoes and tomatoes. The difference is, however, sufficient in their use in the body to make it advisable, when two vegetables are eaten together, to use one starchy and one green rather than two of either. See the table below.

COMPOSITION OF SOME COMMON VEGETABLES

Water	Starchy Vegetables	Carbo-hydrates	Protein	Ash (indicates Mineral Matter)	Green Vegetables	Water
%	Potatoes	%	%	%		%
75.	White	20.6	2.	1.		
70.3	Sweet	27.4	1.8	1.1		
73.	Corn	19.5	5.	.7		
80.3	Parsnips	16.1	1.4	1 +		
79.9	Peas	13.3	3.9	.8 —		
87.2	Beans	7.5	2.2	.7 +		
87.6	Onions	9.5	1.4	.6 —		
88.6	Carrots	7.6	1.1	1.		
88.5	Beets	7.9	1.5	1.		
93.4	Pumpkins	3.9	2.4	1.1 +		
		3.9	2.4	1.4	Cabbage	90.5
		3.5	1.3	.6	Celery	94.5
		3.9	1.4	1.6	Lettuce	93.6
		3.2	.8	.4 +	Cucumbers	95.1
		2.2	.9	.5	Tomatoes	94.3
		1.8	2.1	2.1	Spinach	92.3

+ means slightly more than
— means slightly less than

Hundredths over 5 have been called a tenth; under, were dropped

(Examine for general information only) Adapted mainly from Olsen's "Pure Foods"

Add the solids of each together. Then write the vegetables in the order of the amount of water that these solids show each must have. Consider ash mineral salts. Compare the quantity of it in each with the amount of the other solids in the food. In what order should the vegetables be arranged to show this?

Experience in eating teaches much about differences in vegetables that is not so practically learned otherwise. But science alone can explain what is experienced and give information that living could not disclose without such study. Examination of the chemical composition of foods shows that some are much alike which may seem different, also the reverse.

Though refuse is purchased it is not usually in foods as eaten. The water in the edible portion of food is consumed. Though it does not nourish, it serves in body-regulation.

Which vegetables should be used together to supplement one another? Which should not be because they would duplicate one another? Which of those that have much starch seem more nearly like "green" vegetables? Are they in composition? Parsnips and carrots are usually considered similar. See their composition. Note the similarity of the composition of pumpkins and cabbage.

For Complete Table of Food Composition, see Index.

Starchy, leguminous, and green vegetables have not only general differences but many specific variations within these groups. These alter the value of foods and their combination. Some foods nourish. Some make a diet palatable. Others by adding bulk promote peristalsis. Still others serve in regulation of body-fluids.

How foods are raised affects the dangers they may distribute. Celery, radishes, and such other ground-vegetables bring soil-dangers. All vegetables eaten raw, without skins to remove, as lettuce and salads, generally carry the dangers of soil fertilization, dust, and general handling. Their freshness need not be impaired to insure safety; if washed in boiling water and plunged into cold, crispness is revived and the food safer.

The waste in food is not always evident even when real.

Refuse in vegetables

None — spinach, tomatoes skinned, peas and beans dried.
7–15% — beans (7%); onions (10%); cabbage, cucumbers, lettuce (15%).
20–30% — potatoes (also sweet), parsnips, beets, carrots, celery (20%); turnips (30%).
45–60% — green peas (45%); squash (50%); sweet corn (60%).

When it is remembered that *water* as well as *refuse* enters largely into the composition of vegetables as procured, it is realized that bulk is a significant characteristic of vegetable food.

Where the nutritive substances are in foods and how they are physically arranged affect their availability. Potatoes have an outer and inner skin. Both are richer in protein and salts than the flesh of the potato. Potatoes when peeled raw not only remove more nutrients than when peeled cooked, but in cooking permit the nutrients to be also dissolved out, as potato protein is in soluble form. Potato cooking-water, if the process is begun with cold water, contains $\frac{4}{5}$ of the protein. But if plunged in boiling water, even peeled potatoes lose less than $\frac{1}{10}$; unpeeled, only $\frac{1}{100}$.

Slight nutriment (promote digestion) *Palatability*

Eggplant — $\frac{9}{10}$ water; solids mainly starch. (Breading increases value.)
Cabbage — $\frac{9}{10}$ water. Eaten raw retains nutrients. Cooked loses half.
Cucumbers — over $\frac{9}{10}$ water. Used only for palatability. No food-value.
Tomatoes — over $\frac{9}{10}$ water; sugar over $\frac{1}{2}$ solids (sugar and protein soluble. Use juice therefore); some malic acid. Remove tomatoes from tin whenever not sealed air-tight.
Lettuce — over $\frac{9}{10}$ water. Valued for chlorophyll (green coloring matter). Contains iron.
Onions — valued for oils giving flavor. Stimulating to digestion.
Melons — solids $\frac{1}{10}$, mainly sugar, that with oils and acids gives the flavor.

Protein and simpler compounds (of dietetic value) *Tissue-Formation*

Celery — $\frac{9}{10}$ + water. Valued for nitrogen compounds significant in diet.

Asparagus — over $\frac{9}{10}$ water. More protein than many vegetables, also asparagin (nitrogen compound).

Spinach — over $\frac{9}{10}$ water; protein 1 to 4 carbohydrates. In potatoes protein 1 to 10 carbohydrates.

Beans — nearly $\frac{1}{4}$ protein (more than in meat); less fat than other vegetables or cereals; ash equal to that of cereals; rich in potash and lime. String beans nearly $\frac{9}{10}$ water; as eaten, protein $2\frac{1}{2}$ per cent. Lima beans as eaten have more protein, as pods are discarded. Nutritive and aid digestion of other foods.

Peas — similar. Nutritious as vegetable or soup. Canned may be colored undesirably with copper salts.

Lentils — similar, but smaller. Nutritious.

Peanuts — similar to beans but much more fat. Like beans, peas, lentils (leguminous). All legumes digest slowly and require much intestinal work.

For starch, sugar, and some minerals (these furnish) *Heat Energy*

Potatoes — *white:* $\frac{3}{4}$ water; $\frac{1}{4}$ starch, mainly; salts, $\frac{3}{4}$ potash, $\frac{1}{5}$ phosphoric acid; $\frac{1}{50}$ protein. *Sweet:* more solids; 6 per cent sugar; keep less well (starch more stable than sugar).

Corn (sweet, green) — $\frac{3}{4}$ water; $\frac{1}{4}$ solids ($\frac{1}{2}$ starch, $\frac{1}{4}$ sugar, $\frac{1}{20}$ protein when young). (Carbohydrates increase with ripening.)

Parsnips — over $\frac{3}{4}$ water; 3 per cent sugar; 3 per cent starch, exceedingly fine grains; more fat; salts, $\frac{1}{2}$ potash, $\frac{1}{4}$ phosphoric acid (see potato above); more fiber, increasing peristalsis; more flavor promoting palatability.

Beets — $\frac{1}{2}$ the solids of potato, solids $\frac{1}{2}$ sugar.

Carrots — similar, but no starch; sugar and pectose as carbohydrates.

Turnips — similar, no starch nor sugar; pectose mainly as carbohydrates.

Squash — similar, with food-solids starch mainly. Pumpkins similar, but less solids. (Sugar is soluble, so dissolves in water. Baking prevents loss.)

(Facts stated above are in the main from Snyder's "Human Foods.")

Plants live. They grow from seeds. They develop the constitution of their plant family. Their developing is called maturing. They blossom, bear fruit, and produce seeds. This process repeated season after season is known as reproduction. Nature's method of continuing the life of vegetation is by physically renewing thus its products. Plant life gives definitely the processes of plant-living.

The readiness of plants for *food-use* and for *reproduction* of their kind is not usually the same, because in forming the seed the plant changes itself. The seed itself may be suitable food. When the seed is a human food the rest of the plant usually is not, as bean-pods. Cucumbers gone to seed are not good food, nor are potatoes raised for seed. When other parts than the seed are used for food, these are usually desirable when young or when just full-grown. Cellulose in young plants is tender, later woody. Green vegetables are therefore better young. Starch increases with maturity. Sugar when present does, too. Foods valued for these constituents are of course desirable only when these are produced in them.

Living substances in the main form human foods. Usually anything in food not derived from something that lives itself is not human food. Often such substances when introduced into food are not included in order to nourish the body, but to keep the food from such deterioration as would make its use impossible. It is only commerce overkeeping food and industry using inferior food that introduce non-food materials extensively into human food. Some condiments are of other than direct living origin. Common salt is, and is necessary to life.

Experience in living has taught humanity in which stage of development each plant is best as human food. This age-long habit is followed in choosing vegetable foods.

Conditions under which different foods retain desirable quality indicate the necessities in preserving them. Preservation of food is such treatment of it as will keep it in suitable condition for human use. Green vegetables even in season are perishable. Prompt use is therefore the essential precaution against their deterioration.

Plants are living until they decay. They need the conditions of life, as air to breathe, though after they are plucked they need no longer the requirements for growth, as food. For seasonal use low temperature, complete cleanliness of receptacles and atmosphere, including protection from dust, are usually adequate attention in markets, shops, homes.

Green vegetables lose freshness, and wilt. Some lose sweetness ; fresh corn and peas do. Since they need to be kept in cool, dry air, they should be in a clean, wholesome, well-ventilated cellar or refrigerator. Slightly wilted vegetables revive by standing in water, but this may dissolve out their salts, also some protein and sugar. Lettuce wrapped in a moistened cloth and placed on ice remains crisp. If leaves discolor, remove at once. Vegetables should not be washed until they are to be used, as such moisture may hasten decay or mold-growth.

Starchy vegetables, such as potatoes and beets, need to be kept where it is cool and dry, and with *little air* in actual contact with them. They therefore keep well piled in cool, dark bins. The air of the room should, however, be fresh. Freezing and thawing changes vegetable-composition and should be avoided. Sprouting too renders a vegetable undesirable for food.

The regulation of moisture, light, temperature, is important because the degrees of these affect differently the growth of the various bacteria as well as the natural processes of decay in the plant itself.

Cooking food tends to break it up, thus preparing it for digestion. Cellulose in vegetables needs loosening and softening, so the nutritious substances associated with it may not be lost, because so fixed in this practically indigestible fiber that the digestive juices of the body do not reach them. Besides the aid of cooking, chopping vegetables fine assists in their digestion as often will treating a vegetable, as spinach, with vinegar. *Thorough mastication always increases digestion.*

Germs in food are generally destroyed or rendered harmless by cooking. This increases not only the safety of food but also the probability of undisturbed digestion.

Flavors of food are sometimes developed by cooking, but they may also be lost. In cooking vegetables the latter is the usual danger. Those delicately flavored, as cauliflower, cannot be cooked long or in much water. Those with strong juices often need several waters and longer cooking; cabbage may. Vegetables cooked uncut retain flavor that cut they would lose. Cooking-water from vegetables contains many of their nutrients, especially salts, which have dissolved out. It should be used in dressings or soups. This necessitates thorough washing of all vegetables and removal of too strongly flavored parts. Palatability of food is affected by flavor. Digestion is stimulated by palatable food.

Young vegetables require less cooking than old. The difference in starch present partly accounts for this. Starch inadequately cooked makes work for the body by burdening it with undigested food. Thoroughly cooked starch does work for the body by providing it with energy. All vegetables need to be salted as they are cooked. Fresh vegetables require less cooking than wilted. The water lost must be returned in cooking; the toughened fiber must be revived.

The structure of vegetables controls somewhat the manner of cooking. Rapid, hard boiling is needed for very much incased vegetables, as asparagus, especially if also delicately flavored. Baked food cooks in steam generated from the water in the food itself. The salts of foods are thus retained and the starch is more fully transformed for digestion.

In cooking, physical structure changes, germs are destroyed, flavor is preserved or modified, preparation for digestion begins.

The indigestible material in a food affects its nutritive value in several ways. The separation of it from the nourishing substances is an essential precaution in food-preparation. Cooking, grinding or chopping, masticating, dissolving, aid.

Raw food needs great care. Its freshness is of real value.

Vegetables should be clean themselves, kept so, and handled by no diseased persons. Decaying vegetables are unwholesome. The effect of unsoundness spreads beyond the parts seen as unsound. It rarely can be wholly removed by removing these. Germ-development is prevented by low temperature, pure dust-free air, and sunlight. Pure water too is protective against germs, so long as it remains pure.

Intelligent care of food is a health-help, also an economy.

What humanity has found suits its need is disclosed by the food-supply. This is general advice from race-experience. Living acquaints one with this. But only learning what each food is and does can teach when each should be used. Seasons and stages of development are given with the specific foods.

Grains are more closely related in composition to leguminous vegetables than to other vegetable foods. They serve similarly in the diet. Fruits, spices, nuts, differ somewhat from grains and vegetables and serve different food-purposes.

Vegetables have value in human diet only as they serve directly or indirectly some food-need of humanity. The condition of vegetables affects their food-usefulness as much as does their kind. All kinds do not serve alike; nor do all qualities. Inferior quality of the right kind for the purpose may even cause disease. All food should always be a health-help, strength-giver, work-aid. To make it so, *it must be selected with knowledge of the food-need and quality of the food eaten.*

Selection of vegetables suitable for human use is a daily occupation of those determining the food of humanity. Food may through manipulation in preparation be made to appear well irrespective of its actual quality. This is to be avoided. It menaces health and may life. Safe and unsafe food, sound and unsound food, need to be easily distinguishable. Over-ripe tomatoes have developed in them acid not present earlier. This makes them undesirable and may dangerous. Preparation with seasoning, as in catsup, may make such tomatoes a palatable food, but does not overcome the result in that food of the overripeness of the tomatoes. Such food-preparation is to be discouraged by disuse.

Digestion is hindered by selection of unfit food. Malnutrition instead of nutrition results. Underripe food sometimes contains undeveloped substances not ready for human use. Green apples do. Foods picked green rarely ripen naturally. Choose those gathered ready for use, and use promptly. Overkept food may have lost what it was desirable it should retain or may have developed what it is essential it should not have. Such food is both more exposed to contamination and less able to resist it. Vegetables may carry human disease from the soil, receptacles, or persons. They may also be diseased themselves. This destroys their value as food.

The human need for food is considered in Food Science, pp. 160–224. Precaution in production of vegetables is of great significance. Such food as green vegetables, being often eaten raw and being without covering to remove, such as fruit has, can carry disease from all sources. Fertilization of green gardens with waste products of living, as sewage, may propagate human disease and is to be avoided. Scrupulous cleanliness is essential with such foods. Even washing in boiled water vegetables to be eaten raw is advised if the purity of the water-supply is in any doubt.

Plants show their health and vegetables their quality readily upon observation. But skill in seeing comes only with looking and learning for what to look. Plants droop and die when not sound or cared for well. Vegetables wilt and decay when their vitality is waning. Such indications show the state of health of the food itself. The human disease germs a food may carry may have no apparent effect upon the food itself; the danger is to those who eat food so laden. Precaution against dust everywhere, flies, insects, and any form of contact with illness or waste-products is too little practiced anywhere.

Vegetables differ widely in coarseness and fineness according to the care exercised in their production. This is notably so in lettuce. Superior production should be practiced. Such difference in food-quality is not to be confused with natural difference in degrees of fineness, as in cabbage and cauliflower, that are otherwise so much alike. Both these are desirable. Cabbage is coarse, yet it can be chopped and so prepared as to be a delicate food. This precaution should be taken. Cabbage is more digestible so.

Digestibility of food as well as its composition determines its nourishing power. About 85% of vegetables is digestible.

Plant foods include more than vegetables. Grains, fruits, spices, nuts are also products of vegetation. These enhance the beauty of Nature as well as aid in sustaining physical life. Many of them carry their charm into food and as food do more than nourish by supplying beauty too. They support life by furthering the processes that make food of possible use to the body. The wonder of the working together of living things is nowhere more real than in the food realm. Food sustains life. What it is thus passes into what food does for the body. This in turn makes possible the work the person does. Plants bear fruit that bears further fruit through its value in human life.

Grains have played a race-long part in the food of humankind. Around them clings much of the mystery of the harvest, celebrated wherever the fertility of Nature stirs the emotions of humankind. The compactness and richness of grains has made them symbolic of productiveness. Yet to humankind to-day grains as grains seem less human foods than many substances that appear in the form in which they grow, such as vegetables, fruits, nuts. Grains lose their identity in usually being ground into flours.

With the coming of peoples from other lands have come too their foods for them and to us. Thus have come forms of grain foods new here and of value. Not a few of these are preparations that serve as vegetable foods, as does macaroni. See Foreign Foods, p. 214.

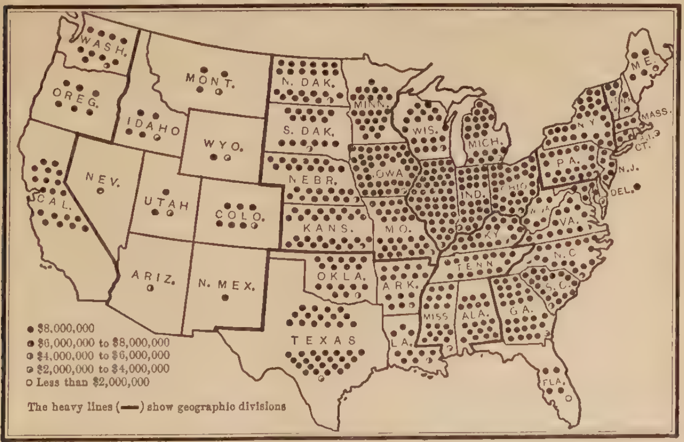
Cereals have of late assumed greater importance as breakfast foods and for children. Though this is not denied them by science, science emphasizes it less than does commerce. Some cereals serve as vegetables; hominy does. Rice (*unpolished and uncoated*) like potato serves as a palatable starchy vegetable.

The conditions under which grains will grow are such as to make their widely distributed growth possible.

PROBABLE NATIVE HOME OF GRAINS

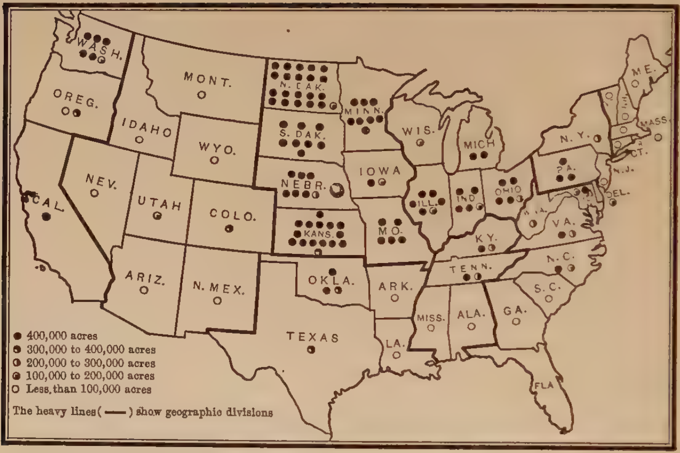
(Redrawn from Frederic LeRoy Sargent's "Corn Plants." Used by permission and special arrangement with Houghton Mifflin Company, as are the cuts of different grains on pp. 20–21)

DIAGRAM OF CROP-PRODUCTION IN UNITED STATES — 1909



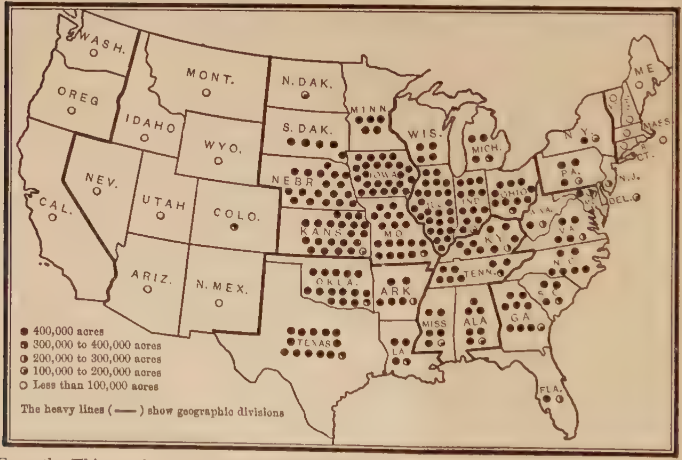
(From the Thirteenth Census of the United States, 1910)

WHEAT ACREAGE BY STATES—1909



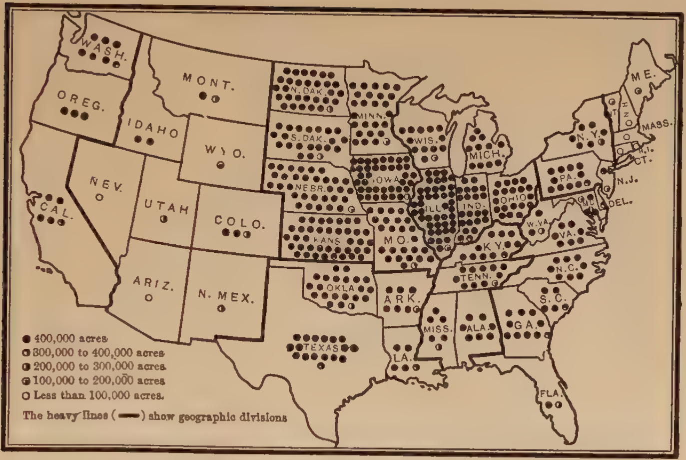
(From the Thirteenth Census of the United States, 1910)

CORN ACREAGE BY STATES—1909



(From the Thirteenth Census of the United States, 1910)

CEREALS ACREAGE BY STATES — 1909



(From the Thirteenth Census of the United States, 1910)

Acreage in	Barley	Buckwheat	Oats	Rice	Rye
New England	16,242	28,725	223,221		13,221
Middle Atlantic	87,733	592,159	2,518,886		472,132
North Central, East	1,007,102	139,971	11,225,445		968,558
" " West	4,762,928	25,955	15,710,495		470,582
South Atlantic	15,561	84,864	1,368,832	27,080	157,546
South Central East	5,388	4,772	870,762	560	50,091
" " West	14,253	121	1,276,534	582,523	5,926
Mountain	313,606	316	1,164,204		32,115
Pacific	1,475,893	1,165	801,062		25,390

(From the Thirteenth Census of the United States, 1910)

On five skeleton maps (or trace maps of the United States if such working-maps are not available) dot in the above facts as in maps shown for wheat and corn. Compare wheat and corn on maps showing acreage with the statement below.

Cereals 191,395,963 Acreage in United States — 1909

Barley	Buck-wheat	Corn	Oats	Rice (Rough)	Rye	Wheat
7,698,706	878,048	98,382,665	35,159,441	610,175	2,195,561	44,262,592

CEREALS — COMPOSITION


Rice


Oats

Cereals as human foods are grain-seeds. Grains are harvested when matured. Seeds are compact and rich in nutrients. Their richness is due to the germ that renews their life and also much plant-food. This supplies the needs for early plant-development when the seed becomes detached from the plant that has been its living connection with its food-supply. Thus another plant forms and later produces seeds. These reproduce again the part of vegetation the plant is.

COMPOSITION OF CEREALS

WATER	% IN	PROTEIN	FAT	*CH*	*MM*
14.3	Buckwheat	6.1	1.	77.2	1.4
12.7	Rye	7.1	.9	78.5	.8
12.4	Rice	7.8	.4	79.4	.4
12.9	Corn meal	8.9	2.2	75.1	.9
10.8	Barley	9.3	1.	77.6	1.3
12.5	Wheat, Winter	10.4	1.	75.6	.5
11.6	Spring	11.8	1.1	75.	.5
11.8	Graham (flour)	13.7	2.2	70.3	2.
12.1	Entire wheat	14.2	1.9	70.6	1.2
7.2	Oatmeal	15.6	7.3	68.	1.9

The concentration of the nourishing substances and the widely distributed growth of grains make them foods of common value wherever humanity lives. The usual palatability of foods made of grain flours or meals makes their constant use in the human diet possible and desirable. Compare composition of cereals with that of other human foods.


Barley


Rye

GENERAL COMPOSITION OF HUMAN FOODS

WATER	% IN	PROTEIN	FAT	*CH*	*MM*
80–90	Vegetables	1–14	1–2	3–85	2–5
7–14	Dry grains	15–20+	1–3	60	2–5
40–60	Meats	15–20	15–30		1–15

CEREALS — PREPARATION

Maize

Corn-ear

Grains are prepared for human food. Dried they lose water; milled, salts. Cereals require much water; also cooking. The cooking-time for cereals not partially cooked indicates the difficulty of breaking up the grain so that its constituents can be made available for food. See table below. Starch is the chief constituent that requires much change. As always, it needs prolonged cooking to make it into the substance (a form of sugar) that is soluble, therefore more digestible.

COOKING CEREALS (Adaptation of facts from Miss Farmer)

CEREAL		WATER	HOURS		CEREAL-PREPARATION
Corn meal	1 C	3½ C	3		Preparations of corn: *samp*,
		4 C	1	1 C	*maizena*, *hominy*, etc.
Oatmeal (coarse)	1 C	4 C	3		Preparations of oats: *H–O*,
					Rolled or *Quaker Oats*, etc.,
		1¾ C	½	1 C	*Rolled Avena*
Rice (steamed)	1 C	2¾–3¼ C	¾–1		(Keep these preparations in glass and stopper. Use promptly)
		(according to age)			
Rye flakes	1 C	1¼ C	⅓		
Wheat (steamed and rolled)	1 C	1¼ C	⅛		*Wheatlet*, *Wheatena*, *Wheat*
		3¾ C	½	1 C	*Germ*, *Wheat Toasted*

Cooking with water changes proportions of ingredients:

Raw oatmeal: *W* 7.2% — *P* 15.6% — *F* 7.3% — *CH* 68%
Cooked: *W* 84.5% — *P* 2.8% — *F* 5% — *CH* 11.5%

Different cereals, because of different composition, are advisable at different seasons, according to their heat-giving power.

Oatmeal, corn meal, (barley, rye, wheat) ground, gluten, hominy, rice.
In winter, use from left to right. In summer, use from right to left.

Cereals are cooked as gruels for infants and invalids in need of liquid food; as porridge (with less water) for children. For adults in health, cereals are cooked as dry as palatability permits and should be thoroughly masticated to insure digestion.

There are over 50 kinds of cereal-preparations on sale. More than half of these have appeared within a decade. They differ little in food-value. Their cost greatly exceeds that of the cereals from which they come. The original cereal is as valuable as a food. It usually needs longer cooking.

Some of the protein of grains is gluten. The most gluten is found in the protein of wheat (14%) and rye (10%). Barley, buckwheat, corn, contain less gluten (7%–9%). This characteristic affects the usableness of a flour for raised bread, as it is the gluten that enables bread to be made into loaves.

(Place 2T flour in cheese-cloth. Twist into bag and knead in water. Starch is thus removed. Gluten mass remains. Pull it.)

Gluten if not creamy-white and elastic makes poor bread. As rye is the only flour besides wheat in which there is a large percentage of gluten, it is the only other flour valuable for raised bread. Other flours are mixed with wheat for raised bread or made into flat breads.

Baked bread is from $\frac{1}{3}$ to $\frac{1}{2}$ water. When $\frac{1}{2}$ water, bread is poor and keeps poorly. It molds readily. Bread needs to be made of ingredients of good quality. Eating it, even masticating it, with other foods increases digestion of both it and them. Bread is a *nutritious food* of *permanent palatability*. Bread is combined in the diet with butter, eggs, milk. When these are in the bread eaten, they should be decreased in the diet.

Rising-agents used in breads are yeasts and baking-powders. Baking-powders require less time to raise mixtures than do yeasts. But baking-powders leave a non-food residue; yeast does not. Foods raised with baking-powders are therefore considered less digestible than yeast-leavened foods.

The fact that starch is the principal ingredient of all grain foods and of starchy vegetables too makes each when present in the diet affect the quantity of the others desirable at the same time.

Rich unsweetened flour foods unite nutritiously with soups and salads. Crackers are dry and have more fat and starch than bread and less protein. They combine with milk and cheese acceptably. Pastry to which fruits or meats are added in the making are substantial foods. Use as such.

Sweetened flour-mixtures, as cake, because not desirable with meats, soups, salads, form another course in a meal. Fruits and ices supplement cake palatably.

Grain foods are usually ground for human use.

Grinding buckwheat

Many conditions affect somewhat the composition of grains. Wheats illustrate this. The variety of wheat, soil, climate, all affect the composition of the resulting grain. The constituents that vary significantly are starch and protein. Wheat is planted in the fall or spring. It is called winter or spring wheat according to the time of planting. Winter wheats are usually softer than spring. Soft wheat contains less gluten (this is a protein) and somewhat more starch than hard. (See p. 20.)

Different wheats are used differently. It is a very hard variety of wheat which is used in the manufacture of macaroni. There are white and red wheats as well as hard and soft. The grinding of wheat-grains makes further differences in the grades of flours. These serve different purposes according to their constitution as well as composition.

Constituents of the grain are not so arranged in it as to be found uniformly distributed throughout it. See diagram below. Starch is usually in largest quantity near the center and protein near the hull. Wheat-hulls themselves make the bran used by cattle for food. The proportion of mineral salts and protein in it are higher than in the flours used as human food.

In bran: *P* 15%; salts, 8%
In flour: *P* 8%–14%; salts, 1%–2%. — Olsen

Milling flour follows harvesting and winnowing. "Screening" removes everything not grain. "Scouring" cleans the grain. "Breaking" with heavy rollers grinds it. "Bolting" sifts it. There are 5 breaks and many siftings through bolting cloth of increasing fineness.

Wheat-grain
(With covering)

Products of Milling

"Scalpings," coarsest; "dustings," finest; all others are called "middlings."

Siftings are mixed according to fineness.

Bran is last scalping and is cellulose mainly but with much protein and salts fixed in it.

Wheat-grain
(No covering)

Bread, the "staff of life," is a staple food of humanity.

Every one may not see a wheat-field and flour-mill as related to making bread. All may not even realize that flour is the principal ingredient in this, but it is. Descriptions of fields and mills show but vaguely the growth and activity through which flour is produced. Only seeing the processes makes real the part the field and mill have in their product — flour and its products, flour-mixture foods.

(Ask parents or teachers to make such seeing possible. If it cannot be now, reserve it as something to be done when the opportunity offers.)

Wheat grows from different seeds and at different seasons. It is ground into flour. It is milled as many different flours: as entire-wheat, graham, white bread-flour, pastry-flour, and macaroni-flour. Use, if possible, bread- and pastry-flour.

Other grains, as rye, rice, corn, grow similarly. They are similarly treated and serve as flour or meal. See all flours, also different qualities. Use as many as possible.

Flour is always the product of grinding grain. The quality of the grain, the mixing of the products of the various siftings, the care in handling and storing the flour, and the health of workers determine the quality and wholesomeness of flour-products. Grains must be dry and clean, and kept so. Otherwise they become diseased and carry illness instead of health-giving food to humanity.

Composition of food substances largely controls their usefulness, but their characteristics control their *usableness.* What is in a food feeds the body. But how nature has arranged and composed food-materials affects whether they can be of use in the body. Bran even finely ground is not digestible. When mixed with other siftings, as in graham flour, it still does not digest and may irritate the intestine.

Oat-grain

Wheat

Grains are dry. So therefore are the flours made from them. These contain relatively little water. Wheat flour of good quality takes up water to about two thirds its own weight.

Starch is the substance of which there is most in flour. It forms about three fourths of the weight of flour. This makes flour-mixtures heat-giving and energy foods. Protein, the tissue-building substance in food, is present in flours in larger quantity than in most plant foods. There is approximately *P* 10% — *W* 10% — *F* 1–2% — *MM* 1–2%. That amount of fat is large for plant foods. Animal foods contain much more. The mineral salts are present in relatively high proportion, but, as noted, are not always fully available to the body as they exist in grains and flours.

Gluten is the constituent that makes a moist mass of flour cohere as it expands when heated.

COMPARISON OF THE COMPOSITION OF DIFFERENT FLOURS

WATER	SALTS	FAT	% IN	PROTEIN	STARCH
11	1.	1.9	Entire wheat	14	72
11	1.8	2.2	Graham	13	71
12	1.5	1.1	White	11	75
10	1.3	.9	Macaroni	13	74
13	1.	1.9	Corn meal	9	75
12	.4	.3	Rice	8	79

Wheat flour that is not creamy-white is usually inferior.

Pastry-flour is wheat flour with the gluten largely removed. It is mainly starch. It makes more delicate mixtures.

Macaroni flour is also from wheat. It has more gluten than is usual in wheat bread-flour. Macaroni is used as a vegetable.

Corn meal and rice both lack gluten. When used in breads they need to be mixed with flour to be cohesive. Alone they are friable and crumble. Use as vegetables too.

Raised bread is leavened bread, whether raised by yeast or other rising-agents. The earliest breads known were unleavened. They were made of ground grain mixed with water. They were formed into flat cakes and baked on hot stones or allowed to dry. It was noticed that dough grew in bulk while unbaked. This made it porous and light when baked. Bread is now thus made.

Breads are to-day made of flour (preferably rich in gluten); water or milk; yeast for leavening, with sugar to further fermentation; salt for seasoning; usually butter or lard to enrich and make tender in texture.

It is gluten that holds the yeast distributed through the mass as the bread is kneaded. Later it holds the gas formed as the yeast grows. It is thus that the loaf is expanded. Baking hardens gluten, so forms the loaf.

COMPARISON OF COMPOSITION OF BREADS OF DIFFERENT FLOURS

W	*MM*	*F*	% IN	*P*	*CH*
38	1.3	.9	Entire wheat bread	10	50
36	1.5	1.8	Graham bread	10	52
35	1.1	1.3	White bread	9	53

COMPARISON OF COMPOSITION OF DIFFERENT BREADS

W	*MM*	*F*	% IN	*P*	*CH*
$\frac{1}{10}$	(Does not differ greatly)	$\frac{1}{100}$ —	Flour	$\frac{1}{8}$	$\frac{3}{4}$ +
$\frac{1}{3}$ +		$\frac{1}{200}$ —	Bread	$\frac{1}{10}$ —	$\frac{1}{2}$ +
$\frac{1}{3}$ +		$\frac{1}{100}$ +	Bread with lard	$\frac{1}{11}$	$\frac{1}{2}$ +
$\frac{1}{3}$ +		$\frac{1}{200}$ —	Milk bread	$\frac{1}{10}$ +	$\frac{1}{2}$ +

The difference in water present in breads is slight, also that of starch. Milk adds the protein of milk and thus increases this in milk-bread by about 1%. Lard or butter slightly increases the fat. Water bread dries more quickly than the richer breads.

In bread-making much happens. Science now explains the changes that occur. Yeast grows while in warm dough. This causes a fermentation. Carbon dioxid gas is formed, also alcohol. The gas and steam expand the loaf until high heat in baking checks further growth of yeast. This heat vaporizes the alcohol, so it is not left in the bread.

Besides the yeast that raises bread, other organisms are present. Many of these may produce undesirable effects, one of which is the souring of bread. This happens when bread has been allowed to rise too long or bread sponge is left uncovered. Active yeast and, after rising, prompt baking in a well-heated oven tend to prevent bread from souring or falling. Heating the milk used lessens such danger, as does warming flour before mixing bread.

Baking bread may not destroy all germs present, but it lessens the probability of their further activity. As molds and bacteria readily grow in bread, it requires proper care. It needs to be kept in a clean, ventilated box, not exposed to dust nor handled by diseased persons. Bread not made at home should be promptly wrapped after cooling.

Science found in examination of 100 loaves from 100 shops

14 unwrapped loaves each coated with over 10,000 bacteria.
11 wrapped loaves from clean shops averaged only 371 bacteria each.
85% wrapped had less than 1000 bacteria; 62% unwrapped more than 1000.

(From the *Journal of the American Medical Association*, July 6, 1912.)

For children bread needs to be baked slowly at first. It is thus made drier. After the crust is formed the moisture is retained. Cooling bread uncovered in clean, fresh air makes the crust hard. In the crust itself some of the starch is converted into soluble form that tastes sweeter and is more readily digested. This happens also in toasting bread, especially in oven-toast.

Making flour-mixtures light has been brought about in different ways through the ages that cooking has been practiced. Present-day methods probably include something from each of those of the past. But they are now applied with more accurate knowledge of what will happen. They can therefore now be used to do what is desired, while avoiding what would be unfavorable for human food. Better results are thus possible.

Air that fills the spaces between the cells of food, when heated, expands. So does air that is beaten into food. When beaten egg-white is added to a mixture, air-leavening is the method of raising or making that food light. This is not equally applicable to all types of flour-mixtures.

Through experience with such mixtures and foods in general it was observed that foods allowed to stand changed, but not always in the same way. Sometimes the change improved the food, sometimes it left it unfit for use. By studying these changes it was discovered that the atmosphere seemed to contain something invisible that caused this, as it did not occur when air was excluded.

Among the changes noted were rising and molding of bread, souring of milk, ripening of cheese and game, decomposing of meat. It was further noted that some of these changes in food-substances were accompanied by gases being given off.

From early times it has been known that a mixture of flour and water when it stood in a warm place would rise. The cause of this was finally found to be the growth in the mixture of yeast plants that entered it from the air. In growing and taking their food for growth from the mixture it was discovered that they so broke up some of its constituents as to form the gas that expanded in the warm mixture and raised the mixture.

Wild yeasts, as those of the air came to be called, have been studied, as have also the other organisms found with them, such as bacteria and molds. All do not act alike; even all yeasts do not. The yeast now used in bread-making was found to serve that purpose well. It has since been separated and so used. It is not secured entirely free from other organisms, but when conditions favorable for its growth are provided, the result sought in bread-rising is obtained.

The conditions for growth of the yeast-plant are suitable temperature and food. The yeast-plant multiplies by budding.

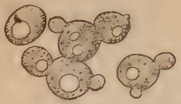
Yeast-plant developing during the process of fermentation

a, *b*, *c*, *d*, successive stages of cell multiplication. (After Green)

The temperature most favorable for this is between 70° and 90° F. At 131° F. and at freezing temperatures yeast-action is destroyed. At other temperatures not between 70° and 90° F. the action may go on slowly, but too slowly for a favorable result in food. Retarded yeast-activity permits other changes to occur through the development of other organisms. These may destroy the value of a food. In bread-rising the temperature needed for yeast-activity may be secured and maintained by keeping the pan of dough in a pan of water comfortable for the hand. (A thermometer should be used whenever possible.)

The food of the yeast-plant is present in bread as now made. Sugar enables yeast to act as a leaven. Some starch of flour is converted into sugar in the form yeast uses. As it uses the sugar, the sugar is broken up. One of the products of this action is carbon dioxid gas. The formation and expansion of this as it is heated produce lightness. The process of breaking up the food-substances of the yeast-plant into carbon dioxid gas and alcohol is called alcoholic fermentation.

Yeast, as it is used in bread-making, varies in form. It may be liquid, compressed, or dry. The form is not important, save as this affects the purity or keeping quality of the yeast. Though the gas produced by the development of yeast is not the only significant effect of its growth, it is this that makes yeast a rising-agent and valuable for leavening mixtures. Yeast must therefore be so prepared and kept as to prevent the formation and escape of this gas before the yeast is introduced into the mixture to be raised by it. Bread made light by forcing carbon dioxid gas directly into it lacks the flavor of yeast-bread.



Yeast cells greatly magnified

(After Conn and Buddington)

Hop

Yeast is a natural leaven. It leaves practically no residue.

When yeast is home-made, it is prepared by cooking potatoes in water in which a few hops have been boiled. Some sugar and flour are added, and the mixture fermented by a little yeast called the starter. Home-made yeast may contain many bacteria and wild yeasts that do not produce essentially advantageous changes in food.

The yeast of commerce is a by-product of distilleries or breweries. The usual form is that of compressed yeast. This is wrapped in tin foil and should be kept in a cool place. *It decomposes easily and produces therefore unfavorable changes when not fresh.* Dry yeast is the same yeast-product mixed with starch or meal and dried. Yeast when dried thus is made inactive for a while. It therefore acts less promptly in a mixture than does compressed yeast but keeps indefinitely.

Baking-powders are artificial leavens. What nature does through the growth of yeast, humankind seek to bring about through baking-powders. The endeavor is to produce the rising effect of yeast by incorporating in mixtures to be raised such substances as will give off carbon dioxid gas when they are united. Baking-powders as commercially produced and practically used are the result of this effort.

They all contain carbon dioxid in some combination. Soda (sodium bicarbonate) and an acid when brought together give off carbon dioxid. This is the general combination of substances used in baking-powders. To prevent the escape of the carbon dioxid until it is needed, the soda is mixed with starch. The acid substance cannot then unite chemically with the soda at once when these are brought together.

The starch so used is called a filler. While dry the action between the soda and acid is prevented ; hence the necessity of keeping baking-powder in closed tin cans or glass jars. When the baking-powder is mixed with a flour-mixture it is then moistened. This causes the soda and acid to combine chemically and give off the gas that expands and raises the mixture, making it porous and light, thereby digestible.

The time a baking-powder takes to form the gas that raises mixtures depends upon the proportions of its ingredients. If the proportion of the "filler" is large as compared with that of the soda-acid combination, then the powder acts slowly. Otherwise it is a quick rising-agent. The commercial value of a baking-powder is based upon its rising quality. The one with the most filler will cost least. The starch filler varies from $\frac{1}{6}$ to $\frac{1}{2}$ the weight of baking-powders as purchased.

In principle of action all baking-powders are alike, that is, they produce the necessary gas.

Baking-powders differ in the substances they leave in the leavened mixture. The *hygienic desirability* of a baking-powder is determined by the *wholesomeness of this residue.* None of these residues is necessary to the mixture and all may be more or less disturbing to digestion. Soda and starch are common to all baking-powders. These are practically harmless. The acid element varies. It is through this that harm may come. There are three usual types of baking-powders.

Cream-of-tartar baking-powders contain cream of tartar and some tartaric acid. These act most quickly and usually cost most. Cream of tartar is left from grape-juice as wine is made. It leaves as a residue the active element of Seidlitz powders. This is laxative in its action. But so little is taken into the body in baking-powder foods that this effect is not appreciable.

Phosphate baking-powders contain phosphoric acid in the form of phosphates. After the action of the baking-powder some of this substance is left in the food. It is not, as is sometimes seen stated, in the same form as the phosphates that are lost from grains in grinding nor is it of the same use in the body as these would be. This residue is present in these baking-powders in much larger quantity than the phosphates of the grains. It acts as a laxative. Phosphate baking-powders do not keep well. They may contain on this account an excess of starch as a filler.

Alum baking-powders contain sulphuric acid in alkali sulphates. These are considered harmful by physiological scientists. They hinder digestion by acting as an astringent, as does the substance commonly known as alum. Alum touched to the tongue puckers the mouth. Alum baking-powder residue taken in food acts similarly upon the digestive tract.

Seek lightness of leavened mixture with freedom from insoluble residue.

As commercial baking-powders are required by law to state their ingredients on their labels, no one need therefore use a rising-agent containing deleterious or doubtful residue. Through only ignorance, negligence or indifference will this happen.

It is possible and economical to make excellent baking-powder at home, as follows:

Soda (*baking*), 2 oz., mixed with *starch*, 1–1½ oz. (or 1½–2½). Shake well. *Cream of tartar*, 4 oz. (from reliable druggist), added, and all well-shaken.

The smaller amount of starch makes a more quickly active powder; the larger a better-keeping powder. Both need to be made of perfectly dry ingredients and to be kept dry in covered glass or tin. Why?

In home cooking artificial leavens may be varied according to the effect of ingredients upon leavens themselves. With non-acid ingredients an acid-element is essential in baking-powder so that chemical action will liberate the gas that does the leavening of the mass. If any ingredients are themselves acid, as are sour milk and molasses, soda alone serves. The acid present then frees the gas from the soda. This method is a home practice that is sometimes used as a convenience or economy. It may improve a food; for were a baking-powder used in acid foods the action would be too quick and a residue unnecessarily introduced.

The time and way of mixing in rising-agents determines their effectiveness. They need to be active throughout a mixture and not to become active before the mixture is formed. Hence the usual sifting of these with flour and no moistening of them until action is advisable. Beaten eggs used to catch and retain air to leaven mixtures are folded in with care at the end of the mixing-process, that they may be effective in this.

Interest in food-quality grows with knowledge about it and experience in endeavoring to secure a pure food-supply.

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A NORWEGIAN WOMAN BAKING FLAT BREAD OUT-OF-DOORS

This bread is made of coarse barley-meal and water, then rolled thin and baked on a flat stone heated by a fagot-fire underneath. When baked this bread is kept in a dry place for winter use. It is said to be clean and palatable.

Bread-flour is creamy rather than pure white, a little gritty, and coheres slightly when a mass is pressed together. The test of a bread-flour is the quality of bread it will produce when bread is skillfully made. This is the method used in judging flour as flour is manufactured. Pastry-flour is whiter and smoother than bread-flour. All the so-called patent flours are made of the middlings, so contain a little less protein and mineral matter and more starch than the usual bread-flour. Three times as much of such flour is produced as of bread-flour. Whole or entire-wheat flour results from grinding the entire wheat-kernel. Graham flour is white flour in which some fine-ground bran has been mixed.

Flour is sometimes bleached to improve its appearance. This is done with the more inferior qualities to remove their yellowish color. This practice is undesirable, as all food should reveal its quality by its appearance and be sold for what it is. It should also be free from all substances not part of itself. The mixing of different kinds of grains, when practiced, should be disclosed instead of concealed. Thus only can one know what is purchased and how it will serve as food when eaten, or select food that will bring humanity the nourishment needed.

Bread needs to be made from reliable flour. Its general use in the diet is due to the fact it contains all food-constituents in significant quantity except fat. Butter used with it adds this. As all peoples now eat bread, so have all peoples in all ages. The breads eaten have differed and do differ. Over fifty kinds of bread are recorded as eaten in ancient times. To-day the kinds are numerous and the differences wide between white breads and the German black bread, the Scotch oat cake, the Swedish flat rye bread (baked only every six months) and the Jewish unleavened bread that resembles a delicate, hard water cracker.

Yeast breads made with a variety of flours serve as the constant bread of humanity. Bread dough, besides being itself made in many ways, is used as a basis for other foods, as doughnuts. These all vary somewhat. Some add fat that bread lacks. Others include more sugar, also fruit and nuts.

Such changes in bread usually increase its heat-energy, but may decrease somewhat its digestibility. They produce variety in the diet and are used for this purpose where the supply of fresh foods is limited and living is largely out-of-doors. These conditions in the early days of New England effected many such modifications in flour-foods not now essentially needed.

Starch, the principal food-ingredient in bread, because gradually digested, makes bread a food that so lasts as to prevent over-frequent need for food. Foods that increase fat and sugar give in these more rapidly available energy than starch can. Starch must be made into a kind of sugar before it can be digested. In bread-baking the starch in the crust is changed to dextrin (a soluble sugar). Hence the advice to give children crusty bread. Adults by thorough mastication of food bring it more fully within the activity of the digestive juices than little children can. Adults can therefore use what children should not even try to digest.

Baking-powder breads vary as do yeast breads. They may be plain or variously enriched. They are usually served hot, so require every care to make them digestible. They include muffins, breakfast and tea breads of all kinds, such as corn-bread, cereal and sweetened muffins, and biscuit.

Many such foods introduce a number of animal food elements in milk, butter, eggs, so are not as distinctly vegetable foods as bread itself may be. This does not decrease their value as foods, but modifies their use.

The range of bread-substitutes is as great as the varieties of bread. These are not only many but come from everywhere and even from many ages of the living of humanity. They are nevertheless of only three general types and can all be so grouped. These are:

Simpler, thinner flour-foods, as buckwheat cakes and fritters of all types, batter cakes and batter-covered foods.

Sweetened flour-mixtures more delicate than bread and usually very palatable, such as all cakes, cookies, and many puddings.

Enriched flour-mixtures more crisp than bread, due to increased fat (butter or lard). Often these are more appetizing than digestible. Such are pastries and even crackers (except cereal crackers that are simply hard-baked cereal-flour-and-water- or milk-mixtures).

Note in the table below the differences in crackers, cake, and breads. Which has most fat? least water? most protein, ash, carbohydrates?

COMPOSITION OF BREAD, CAKE, CRACKERS

WATER	PROTEIN	% IN		CARBOHYDRATES	FAT	ASH
43.6	5.4	Bread	Brown	47.1	1.8	2.1
38.4	9.7		Whole wheat	49.7	.9	1.3
35.7	8.9		Graham	52.1	1.8	1.5
35.7	9.		Rye	53.2	.6	1.5
35.3	9.2		White	53.1	1.3	1.1
19.9	6.3	Cake		63.3	9.	1.5
6.8	9.7	Crackers	Cream	69.7	12.	1.7
4.8	11.3		Oyster	70.5	10.5	2.9
5.9	9.8		Soda	73.1	9.1	2.1

(From *Food Bulletin No. 142*, United States Department of Agriculture) (Rearranged)

Since these foods are all largely flour, they take the place of one another in the diet; that is, no two of these are eaten together. When two are eaten at the same meal, less of each should be than when alone. Cake or pie as dessert makes less bread with such a meal desirable. Cake and pie usually cannot, however, directly take the place of bread.

The fruitfulness of the earth stirs every one that at all realizes it to a sense of wonder. Each fruit of plant or tree, when known for what it is, seems one of the greatest of the marvels that so abound among living things. Vegetation has for every season characteristic charm. Springtime brings anew evidences of growth; summer matures; autumn reaps; and winter keeps alive for nature's use what is needed to renew the life of vegetation and sustain that of animals and humanity. Fruits mean more in the life of vegetation than simply supplying refreshment to humanity. But as human foods, it is refreshment that fruits uniquely bring. Some are also distinctly nourishing, as bananas.

Fruits and vegetables are similar in composition, but differ in some very significant respects. Both contain much water, mineral matter, some cellulose, and protein. (Though most fruits have little more than 1% of protein, this is not an insignificant proportion of their solids; often it is 2%–10%.

AVERAGE COMPOSITION OF FRESH FRUITS

REFUSE	AS EATEN								
	WATER	SWEET FRUITS	SUGAR	ACID	MINERAL SALTS	PROTEIN	FAT	FIBER	ACID FRUITS
%	%		%	%	%	%	%	%	
35	75.8	Bananas	21.7	.3	.5	1.3	.6	1.	
5	78.4	Plums	20.1	1.	.5	1.	—	—	
—	81.9	Huckleberries	16.5	—	.3	.6	.5	—	
25	77.4	Grapes	14.5	.6	.5	1.3	1.6	4.3	
—	85.3	Pineapples	12.2	.7	.3	.4	.3	.4	
25	84.6	Apples	11.3	.7	.3	.6	.5	1.2	
6	85.	Peaches	10.8	.5+	.6	.5	.5	—	
—	86.3	Blackberries	10.9	.8	.5	1.3	1.	2.5	
—	85.		10.	1.5	.6	1.	—	2.9	Raspberries
—	88.9		8.4	2.3	.2	.4	.6	1.5	Cranberries
6	90.		6.	1.1	.6	1.	.6	1.4	Strawberries
27	86.9		5.7	1.4	.5	.8	.2	—	Oranges
30	89.3		.4	5.4	.5	1.	.7	1.1	Lemons

(Constructed from a variety of analyses)

Those foods nourish most that have least water. Among vegetables potatoes, corn, peas, have least water, so more nutrients, that is, substances that nourish. Bananas have least water among fruits, therefore give most nourishment.

Fruits, like vegetables, are of two somewhat distinct kinds, though this is not readily seen except by comparison of the extremes, as bananas and oranges. As starch decreases in vegetables (from potatoes to tomatoes), so sugar does in fruits. Fruits are sometimes distinguished as "food" and "flavor" fruits in recognition of this difference. But all fruits have flavor and value besides furnishing heat-energy, which both their sugar and acids give as these are broken up in the body.

Mineral salts in fruits, such as potassium, are especially important to the body. They are in a form in which the body can use them. It is only as these are associated with organic matter, as they are in fruits through plant-growth, that the body can assimilate them. The flavor in fruit is produced by their complex oils, with their organic acids, sugar and water. Organic acids in fruits, though much alike, are not the same. Apples contain malic acid, as do tomatoes; oranges and lemons, citric; grapes, tartaric. (Baking Powders, p. 33.)

Degree of ripeness of fruit affects its value and usableness as food, since its composition changes as it matures. Unripe contain more cellulose, starch, pectin, and acids.

COMPOSITION OF APPLES AS THEY DEVELOP (Adapted from "Pure Foods")

SOLIDS	WATER	PER CENT IN	SUGAR		STARCH	MALIC ACID
			Cane	*Invert*		
18.5	81.5	Very green	1.6	6.4	4.1	1.1 +
20.2	80.	Green	4.	6.5	3.7	
19.6	80.4	Ripe	6.8	7.7	.2 —	.6 +
19.7	80.3	Overripe	5.3	8.8		.5 —

(These *specific analyses* differ from averaged analyses, p. 38)

Science experimentation in modifying living things has in no realm of life had more effect upon products than in fruit-bearing vegetation. Cultivation is always an effort to improve or refine a product found wild, or by combination of two to produce a third for variety or to secure together only the desirable qualities of each. Grafting and cross-fertilizing are used to do this. In cultivation two efforts are made, namely, to decrease the cellulose in fruits and to improve flavor.

Some foods are palatable both wild and cultivated. This is true of strawberries, though wild differ from cultivated. Mountain cranberries are more palatable and delicate than those of the low-lands bog-cultivated. But by cultivation only are some foods brought into form to render them acceptable human foods. Apples untended return to a wild state that is a stage in their development below the level where they became a desirable addition to the diet of humanity.

Seedless foods are the opposite extreme of wild. The latter are self-grown and bear the seeds that reproduce. Human-grown fruits are cultivated for human food. They are controlled in their growth, so far as control can be exercised, for their improvement as human foods. A fruit without seeds has in it what otherwise would have gone into making seeds or it is in the more tender, less mature stage before seeds form. Thus cultivated seedless fruits are usually more delicate and may be more nutritious too. Sometimes, however, the loss of naturalness in such forced growth is a loss of vital quality. But usually the fruit is preferable as food, as are seedless oranges.

Cultivation of fruit has greatly increased of late years, due to the greater importance attached to it as food and to development of regions especially suited by soil and climate to its growth, combined with extension of transportation facilities.

Nature's spring supply of fresh food begins with early green vegetables, as lettuce and radishes. These are followed by young starchy vegetables, as beans, and later by such as mature late, both starchy and green, as potatoes and tomatoes. The season for fruits opens with early berries and ends with late apples. Using fresh foods as they become abundant secures the best food-supply, also the most economical.

Some such foods are necessary at other seasons. This need is met by storing or preserving them for out-of-season use or by transporting them from other climates where they grow at other seasons. Foods that contain starch keep well because starch is stable, that is, not easily changed. It is because starch does not readily change that it is indigestible raw. Foods to be eaten raw must contain little or no starch; lacking this stable substance, they keep less well.

Green fruits contain much starch. The plant as fruit matures has the power to change starch to sugar. As fruit decays or fruit-juice ferments, sugar is changed further and alcohol is formed. This is the process of wine-production from grapes that are themselves $\frac{1}{3}$ to $\frac{1}{2}$ sugar. Cider is thus derived from apples that are $\frac{1}{20}$ to $\frac{1}{7}$ sugar.

To have fruits fresh for out-of-season use they must be transported or stored. Bacteria usually are the foes of food. Low temperature delays or destroys bacterial growth. Temperature lowered sufficiently to do this, but not so low as to freeze the fruit, preserves fruit palatably during transportation or for six months of storage for reserved use. It is thus fresh fruit is made available throughout the year, but at high cost out-of-season.

Fruits are dried and preserved by cooking for deferred use. Drying deprives fruit of moisture until desired for use. Returning water to it revives it and its flavor somewhat.

Fruits *stored* are kept as nearly as possible in a fresh state. *Dried* fruits have lost water and may contain chemicals used to prevent development of mold; these act also as a bleach. *Desiccated* fruits have water withdrawn from them by exposure to moisture-free heated air. The rapidity of such drying averts the possibility of mold or bacteria growing.

Canned fruits are cooked. Only such fruits as are palatable cooked should be canned. Bacteria must be kept out after cooking. Sealing, with air excluded, is the household practice. In the laboratory it has been found bacteria do not pass through cotton. Where canned food is not to be shipped it can safely be stopped with cotton. Jams and jellies are covered with paraffin for the same purpose.

Jams and jellies are fruit-juices concentrated by boiling fruit with sugar. Jams contain most of the fruit. Jellies have the cellulose (woody fiber), skins, and seeds strained out. Jellies are congealed, strained fruit-juices that have combined with the sugar added in boiling. The pectin (1%) and acid (½%) make this jellying of fruit-juices possible. Tart fruits usually contain pectin and acid in the proportions needed to cause jellying when the amount of sugar required by each fruit is added. Sweet fruits may lack the acid necessary. This lack may be overcome by using the fruit somewhat green, by adding the acid from grapes (tartaric, used in baking-powder), or by adding some of an acid fruit. The last is the preferable method.

Specific preserving processes are special cookery problems, but the facts stated above give the principles that direct such food-preparation and through which it is understood. Commerce markets some jams and jellies of somewhat artificial composition. (See p. 44.)

Dried fruits lose freshness, but in losing water increase the proportion of their nutrients (nourishing substances). Grapes and raisins differ thus, as do also plums and prunes. Such fruits are concentrated foods, because in small bulk there is a high percentage of nourishment. (See table below.) Such dried fruits are wholesome, but are not substitutes for fresh fruits. They serve the body differently. They are principally heat-energy-giving. They combine appetizingly with grain foods, increasing their heat-power and palatability.

COMPOSITION OF FRESH FRUITS (F), JAMS (J_1), AND JELLIES (J_2)

WATER			% IN	SUGAR			ACID			PROTEIN			ASH		
F	J_1	J_2		F	J_1	J_2	F	J_1	J_2	F	J_1	J_2	F	J_1	J_2
85.4	36.8	40.8	Apple	11.3	54.6	53.8	.7	.3	.3	.6	.2	.2	.3	.2	.2
5.		36.7	Crab-apple			58.6			.2			.1			.1
86.3	43.6	40.4	Blackberry	10.9	47.8	57.4	.8	.9	.5	1.3	.7	.2	.5	.5	.3
80.1	44.4	36.3	Grape	16.5	44.8	62.8	.6	.7	.5	1.3	.5	.2	.5	.7	.5
81.9		37.	Huckleberry	16.5		57.			.3	.6		.1	.3		.3
86		31.4	Orange	5.7		65.5	1.4		.2			.4			.3
88	34.4	30.	Peach	10.8	59.6	65.3	.6	.5	.3	.7		.2	.7		.2
84.4	38.5	30.9	Pear	11.4	46.9	65.		.2	.2		.3	.2	.4	.3	.3
85.2	26.1	19.7	Pineapple	12.2	60.5	78.8	.8	.3	.3	.5	.3	.4	.4	.3	.4
78.4	49.6	54.4	Plum	13.3	38.	41.9	1.	1.	1.1	.4	.5	.4	.5	.5	.7
		33.4	Mixed fruit			63.4			.4			.1			.2

(Under .05 is dropped; over .05 is considered .1) Constructed from Olsen's "Pure Foods"

DRIED FRUITS COMPOSITION (Arranged from Norton's "Food and Dietetics")

REFUSE	WATER	% IN	CARBOHYDRATES	PROTEIN	FAT	ASH
10	15.4	Dates	78.4	2.1	2.8	1.3
10	14.6	Raisins	76.	2.6	3.3	3.4
	17.2	Currants	74.2	2.4	1.7	4.5
	18.8	Figs	74.2	4.3	.3	2.4
15	22.3	Prunes	73.3	2.1		2.3
	28.1	Apples	66.1	1.6	2.2	2.1
	29.4	Apricots	62.5	4.7	1.	2.4

Food facts concerning composition and digestibility of foods show their nutritive value, therefore, in how far they are equivalents of one another.

Food scientists have found some jellies and jams made with a common fruit-juice (apple) labeled differently, though varied only by different flavors, natural or artificial; and others of gelatin similarly flavored and sweetened with glucose instead of sugar; and even some entirely alike also labeled differently.

Preserving fruit adds sugar, usually pound for pound. This makes such foods highly heat-energy-giving, so cold-weather foods, while fresh fruit is refreshing food of value in summer. Living quality and freshness of food cannot be overvalued.

Starch changes to sugar as fruit ripens, and acid lessens. (See p. 39.) Cooking unripe fruit changes starch thus, too, so makes it digestible as it is not when raw.

Vegetables develop starch as they mature; fruits, sugar. Fruits contain organic acids (1–50% of their solids). Fruits have also very complex oils and aromatic substances in small quantities which give them their characteristic flavors. Fruits also contain some gums (pectin or pectose), to the presence of which is due the congealing of fruit-juices when boiled with sugar. Pectin is more abundant in unripe than in ripe fruit.

DIGESTIBILITY OF FRUITS (After Dr. Gilman Thompson)

Easily digestible	Apples (baked), prunes (stewed), grapes, oranges, lemons, banana meal
Digestible	Apples (cooked), peaches (ripe), figs, grapes, oranges, lemons, strawberries, raspberries
Less digestible	Apples (raw), prunes, pears, apricots, bananas, currants (fresh), melons
Indigestible	Currants (dried), citron

Fresh fruits promote body well-being principally. Fruits are heat-energy-giving mainly according to the sugar natural in them or added to them. The acids and pectin in foods add some heat-energy. Fruits differ most in sugar and water present. Dried and preserved fruits are less wholesome than fresh, ripe fruit.

The slight variation in the quantities of the other constituents little reveals the many individual distinctions among fruits. Though these small-amount constituents are the ones that distinguish fruits from other foods and act much the same in all fruits, they are not all equally favorable for all individuals. Oranges, apples, strawberries may signally fail to agree with individuals. No class of foods shows this individual difference more markedly than fruits. Change in food-combination may make an unacceptable food digest. Change of season or climate may. But if a food persistently does not, it should be avoided. What does not digest does not nourish, and becomes a harmful agency in the working of the body.

Ripe fruits, fresh and well washed as eaten, are free from the dangers of unripe, dust-laden, or decaying fruit. Raw starch, excess of acids, and cellulose make unripe fruit unsafe food. Fruits eaten between meals and at the beginning (when not exceedingly acid) are laxative, so aid the body to keep free from waste products ; as do also green vegetables.

Laxative fruits are apples, dates, figs, prunes, peaches (ripe), berries, orange- and grape-juice. (Berries are inadvisable for young children. All fruits for children should be skinned and seeded.)

Uncooked fruits are somewhat more laxative than cooked.

Nuts, like cereals, served as sustaining human food in earlier times. Later, nuts passed to use as diet-accessories, that is, food incidentals to substantial diet. When vigorous outdoor exercise was the common practice, food could be excessive, and health somewhat maintained. But with less physical activity, ill-health is the invariable outcome of an overburdened and overworked digestive tract.

As science has developed and engaged in a study of human nutrition, what all foods contain and do has been investigated. Hardly anywhere in the food realm has more light been shed upon diet-mistakes than in the use of nuts. Their very use in nature would make them compact, concentrated foods, as seeds must be to nourish the living germ as it sprouts and becomes a plant. Then only is it equipped to take nutriment from nature's sources outside itself.

The wisdom of earlier peoples is usually carried longest by those whose resources are so limited that they cannot afford to lose what experience has taught others or to overlook what has been found good and cheap. Among such, nuts have continued in use as foods for nourishment. From them have come palatable nut-preparations, as cooked chestnuts (a starchy food of delicate flavor) and peanuts, a building and energy food. Many food-uses of nuts are now practiced, as grated nuts on thin soups and green salads to add what these lack.

Compare composition of nuts with that of other foods in table.

GENERAL COMPOSITION OF COMMON FOODS

WATER	% IN	FAT	*CH*	ASH	PROTEIN
2–10	Nuts	25–60	15–20	2–5	5–20+
40–60	Meats	15–20	——	1–15	15–20
7–14	Grains (dry)	1–3	60	2–5	15–20+
80–90	Vegetables and fruits	1–2	3–85	2–5	1–14

Nuts nourish. Though they build, they are principally energy-giving, due to large percentage of fat. Fat gives over twice as much heat-energy as the same quantity of carbohydrates. Nuts digest slowly; they need thorough mastication.

STUDY OF COMPOSITION OF DIFFERENT EDIBLE NUTS

REFUSE	AS EATEN						
	WATER	NUTS (Shelled)	FAT	CARBOHYDRATES	ASH	PROTEIN	NUTS (Unshelled)
	%		%	%	%	%	
32.6	1.6	Peanuts (roasted)	49.2	16.2	2.5	30.5	
—	2.	Peanut butter	46.6	17.1	5.	29.3	
26.4	9.3	Peanuts	42.	18.7	2.1	27.9	
—	4.2	Pistachio	54.5	15.6	3.1	22.6	
64.8	4.8	Almonds	54.9	17.3	2.	21.	
58.	2.8	Walnuts	64.4	14.8	1.3	16.7	
52.1	3.7	Filberts	65.3	13.	2.4	15.6	
49.7	2.9	Pecans	70.8	14.3	1.7	10.3	
—	3.5	Coconut (shredded)	57.3	31.6	1.3	6.3	
49.6	2.7		33.6	3.5	2.	8.6	Brazil-nuts
62.2	1.4		25.5	4.3	.8	5.8	Hickory-nuts
16.1	31.		6.7	39.	1.5	5.7	Chestnuts
86.4	.6		8.3	.5	.4	3.8	Butternuts
48.8	7.2		25.9	14.3	.9	2.9	Coconuts

(Adapted from a government bulletin, "Nuts as Food")

Nut-cultivation is recent in the United States (*California and Texas*). In 1909 there were produced 62,328,000 pounds; increase of 57.7% in ten years. In 1909, value of crop was $4,448,000; increase of 128.1% in ten years. Walnuts (Persian or English), pecans, almonds, constituted nine tenths of nut crop. Walnut crops doubled in ten years; pecans tripled.

Nut-farms have multiplied rapidly in the United States.

(All data on crops are from "Abstract of the Census — Agriculture.")

In 1909 the United States produced fruits and nuts valued at $222,024,000. This was 4% of the total value of all farm crops. It was an advance of 66.9% over 1899, or a gain of $133,049,000.

Distribution of value of fruits and nuts in 1909 was

Small fruits (strawberries, black-, dew-, and raspberries, gooseberries, currants, cranberries)	$29,974,000
Orchard fruits (apples, peaches, pears, plums, prunes, cherries, apricots, quinces) . . .	140,867,000
Grapes (all varieties)	22,028,000
Citrus fruits (oranges, lemons, grapefruit, limes, tangerines, mandarins)	22,711,000
Other tropical and subtropical fruits, as figs, olives (see below)	1,995,000
Nuts (p. 47)	4,448,000

Acreage for *small fruits* in 1909 was .1% of total improved farm acreage. Strawberries (most important of these), $\frac{1}{2}$ of the small-fruit acreage and $\frac{3}{4}$ of value.

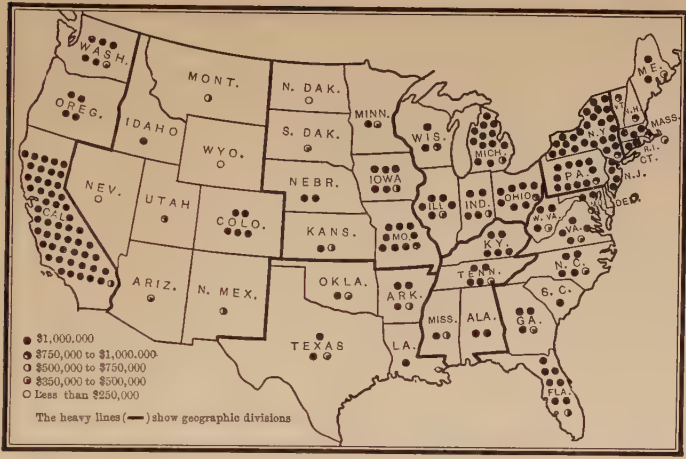
Production of *orchard fruits* in 1909: 301,117,277 bearing trees; 216,084,000 bushels. California and New York led in these products, that are in value 2.6% of all products. Apples (most important product), 59.1% of value of orchard fruits.

Vine-culture in 1909 produced 223,702,000 bearing and 59,929,000 non-bearing vines. Production of grapes was 2,571,065,000 lb. Value .4% of all farm crops. California produced $\frac{2}{3}$ of vines that yielded $\frac{3}{4}$ of grape crop.

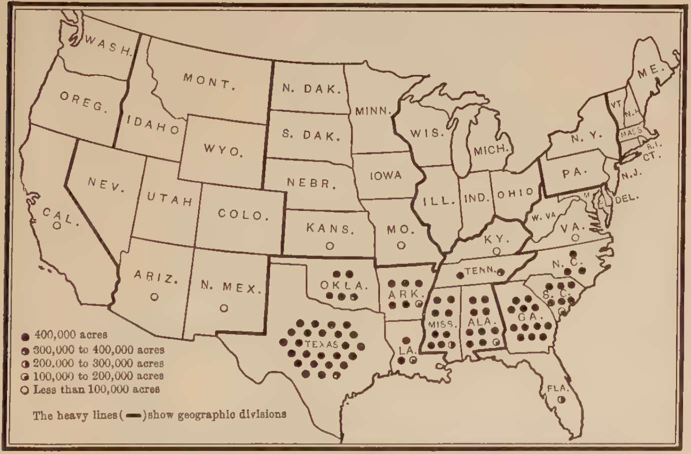
Citrus-fruit production increased 231.1% between 1899 and 1909 — from 7,098,000 boxes (1899) to 23,502,000 (1909). California raised 67.8%; Florida, 28.7%. No increase in production was equal to this of citrus-fruits. Grapefruit led with an increase of from 31,000 (1899) to 1,189,000 (1909).

Subtropical and other tropical fruits raised in California and Florida in small quantities are figs, olives, pineapples, bananas, pears (avocado), guavas, mangoes, persimmons (Japanese), loquats, pomegranates, dates. Olive crop (raised in Cal. and Ariz.) tripled from 1899 to 1909.

FRUITS AND NUTS VALUE BY STATES—1909



COTTON (COTTONSEED-OIL) ACREAGE BY STATES—1909



(From the Thirteenth Census of the United States, 1910)

Edible oils of vegetable origin come from a number of vegetable growths: olives, corn, nuts (as almond, peanut), seeds (as sunflower, poppy), and cotton. Olive-oil has long been used in the countries of olive-culture. The other vegetable oils are of relatively recent development as factors in the usual human diet. With the exception of olive-oil and such fats as are inherent constituents of most foods, fats as human food have been taken from animal foods, such as milk and pork.

Olive-oil and most animal fats are considered more generally digestible by all persons than the other oils that have more recently come into food-use. This is ascribed by many to their more wonted or agreeable flavor. The other oils now prepared as foods are sometimes by-products of processes that serve humanity in other ways. Cottonseed-oil is a notable illustration of this. The more extended use of nuts as a substantial food has led to a new valuation of their fats and a marked and rapid development of their use in made foods also as substitutes for animal-fat foods, as peanut-butter for butter made from milk. These are not full diet-equivalents of the animal fats whose place in the diet they share.

FAT IN HUMAN FOODS *(Compare percentages)*

	%		%	
Olive- and salad-oils	100	supplementary	½	Fruits
Butter and salt pork	85		1	Vegetables and bluefish
Bacon	64		1½	Bread
Chocolate and coconut	50		7	Oatmeal
Ham	40	interchangeable	13	Lamb
Peanuts	38		17	Beefsteak and salmon
Cheese	33		28	Beef roast

Olive-oil is the most highly valued of salad-oils. It is also the most expensive. This leads to its adulteration or mixture with other oils. It needs to be kept pure for human use.

Fruit juices have been noted as refreshing in effect. Fruit acids serve also some cooking purposes, as tartaric acid frees carbon dioxid gas in some baking-powders.

The common acids in human foods are:

Tartaric acid in grapes (1–5%); and in currants (5.8%).
Malic " " apples (.9%), blackberries (.7%), strawberries (1.4%).
Citric " " oranges (1%), lemons (7%).

Vinegar is a manufactured food-acid. It is made from apples by fermentation that converts sugar into alcohol, then acetic acid. Though vinegar is also made from wine, molasses, glucose, it is in all forms fermented. When pure any of these vinegars is satisfactory, though cider and wine are preferable. Spirit vinegar made from corn or barley malt, though cheaper to produce, is less palatable.

Adulteration of vinegar, even with water, is easily accomplished and often practiced. Law now requires that vinegar have acetic acid, 4%; solids (of apple), $1\frac{3}{5}\%$; ash, $\frac{1}{4}\%$. Spirit vinegar may be colored and other additions made to give it the appearance of cider vinegar. No adulteration is ever advisable, and most adulteration is somewhat injurious, even when not obviously dangerous. Its object is always increase in profit. It is improved production that human health requires.

Clear vinegar is the result of completed fermentation and protection from air. During the process of acetic fermentation vinegar is cloudy and forms deposits. "Mother" of vinegar is a fungus growth associated with the acetic-acid ferment. The acidity resulting from completed fermentation inhibits growth of more ferments.

Glass, stone, or wood *stopped* receptacles must be used for vinegar, as it dissolves the household metals, iron, copper, tin, aluminium.

Spices come in the main from tropical plants. They are from roots, bark, flowers, buds, fruits, or seeds according to the plant-part containing the aromatic substance for which the spice is valued and used. The flavor of spices is generally due to volatile oils, as in fruits. They dissipate odors that are usually agreeable. Heated volatile oils evaporate.

Constituents of spices are similar. They are commonly volatile oils, mineral matter, tannin, protein, starch, fiber. These are in different proportions in different spices. The mineral salts differ somewhat and the oils so differ as to distinguish the spices. Some spices are very pungent. Several spices are often mixed to secure a blend of flavors.

Condiments are substances added to food to stimulate digestion. This is the function of spices. Mild stimulation of well-seasoned and well-served food promotes wholesome digestive activity. Excessive stimulation destroys natural vitality and hinders normal functioning of body.

COMMON SPICES DIET-USE

Allspice, cloves, cinnamon (cassia), ginger, nutmeg (mace). Used in flour-mixtures, acid, oil, and sweet food-dressings.

Pepper — black, white, red (cayenne and paprika); mustard. Used with meats, vegetables, and salad-dressings.

ORIGIN

Allspice — dried fruit of West Indian evergreen.

Cinnamon — inner bark of tropical tree.

Ginger—rootstock of tropical herb.

Nutmeg — seed of tropical tree.

Cloves — immature flower buds of clove tree.

Cassia — coarse outer bark and buds. Chinese variety of cinnamon.

Mace — thickened cover of nutmeg.

Pepper — dried berry of tropical shrub prepared as black and white.

Cayenne — dried fruit-pods of tropical and temperate herb.

Paprika — mild Hungarian variety.

Mustard — seed of temperate-zone herb. Black and white varieties mixed.

Some plants contain fragrant substances that can be separated and used to flavor food. These are known as vegetable flavoring extracts. Those commonly so used are the essence of *vanilla, almond, orange, lemon.* Lemon and orange extracts when pure are made from the oil of the fruit-peels. This is dissolved in alcohol. In the United States it is required that in these extracts one twentieth be the fruit-oil itself. Almond extract is oil of bitter almonds dissolved in alcohol.

Vanilla is extracted from the vanilla-bean, the fruit of a tropical climbing orchid that grows naturally in Central America and West Indies and is elsewhere produced, as in Java and very favorably in Mexico. The process of preparing vanilla consists in drying the pods, during which fermentation develops the flavor. The extract is made by soaking chopped dried pods in alcohol and sugar. Vanillin (a crystalline substance) combined with some resin, gum, wax, tannin, sugar, gives the flavor characteristic of vanilla.

Tonka extract is used as a substitute for vanilla. Sometimes it is mixed with vanilla. It is from the seed of a tropical tree. The flavoring matter (coumarin) is less delicate than that of vanilla. Like all substitute food-substances it should be sold as itself. The Pure Food Law requires this. Both vanilla and tonka extracts are artificially produced.

Twenty samples of commercial vanilla when examined showed that all except two contained less than the capacity of the bottle. All except one contained less alcohol than the amount (38%) in pure vanilla extract. Six only contained the amount of vanillin (1–2%) most desirable, which is that present in the bean considered best (Mexican). Other beans contain more. Seven contained tonka extract.

The volatile nature of flavorings makes them pervade foods.

Children need, in the main, to eat foods as flavored by nature.

Flavorings are used to increase palatability of foods that are themselves without marked flavor. When volatile it is essential so to add them to foods that they will not be dissipated during cooking.

Confections flavor a diet as flavorings do food.

The sweet chocolate sold as a candy is usually nearly two thirds sugar. Adulteration of chocolate is possible and somewhat practiced. Cheaper vegetable constituents are substituted; even some inorganic substances are used. Both are unfortunate. The latter may not be wholly safe. Pure chocolate and chocolates of stated composition are needed for all uses of chocolate.

In 1911 the United States imported $4,946,200 worth of spices and exported of these $245,622 worth together with $58,989 worth of domestic production. The quality of spices depends upon manner of growth and purity of preparation. Ground spices are easily and not infrequently adulterated with pulverized nut-shells and grain-hulls. Unground, adulteration is neither so simple nor usual, though still possible.

Use of vinegar is primarily to promote palatability of food. In concentration it is slightly preservative. This limits its use, as it should not be consumed except in small quantity. Vinegar is oxidized in the body, so yields energy. This is, however, so insignificant that vinegar is not considered nutritive. It "cuts" oil, as does lemon-juice too. This so separates oil-particles as to increase ready digestion of oil. Olives are hand-picked and cold-pressed to prevent bruising and decomposing, as both cause deterioration in the oil produced. Great care is necessary and exercised in its preparation to preserve its delicacy.

Dietetic objections to foods are of several types. Glucose ferments more readily than cane-sugar. It is a cheaper product, and the foods containing it should be sold for less than those with cane-sugar. The rapid availability of glucose for use in the body leads to the danger of an excess amount of it being consumed, thus encouraging fermentations.

Heating food frees it from bacteria producing putrefactive odors that would render foods unpalatable, but other kinds of bacteria not killed in cooking, together with those on uncooked foods, enter the intestinal tract, so it needs to be as free as possible of what will feed them.

Complete use of food eaten depends upon the air breathed. If more than four parts of carbon dioxid are present in one thousand parts of air, respiration is impeded, digestion destroyed, health impaired.

Plants at night do not eat and do breathe ; in breathing they add carbon dioxid to the air, so should be removed from sleeping-rooms.

By its beauty nature nurtures humanity as well as nourishes with its fruits.

What nature provides through the agency of vegetation grows in significance as humanity grows in knowledge of its use.

The human system detects the effect of foods by its own physiological reaction to them. This is the test of desirability.

The caffeine, theine, theobromine, that give regular coffee, tea, and cocoa their stimulating characteristics, and tannin (that is astringent and always undesirable), are present in almost incalculably small quantities in beverages as prepared. (Caffeine in coffee as a beverage is 1.24% of 1 oz. in 1 pt. of water, that is, less than .008%.) But their presence even so may have a physiological effect upon the body.

The need of the body for water has led to the development of beverages. Some are palatable; many stimulate; others excite; only a few nourish.

Fruit juices unfermented, as lemonade, refresh, as do fresh fruits. Coffee and tea stimulate, giving to some a sense of vigor, which fails, however, to strengthen. These only sustain without nourishing. Alcoholic drinks of all types excite. They overwork and exhaust the nervous system, so that all that depends upon its wholesome regulation is undermined and ultimately destroyed. Milk preparations and cocoa nourish. These alone should be given to children.

Tea is old in its use. Japan began to use it in 692 A.D. Other lands used it earlier still. As used it is oriental in its origin, exhilarating in its effect, astringent in its action, social in its service, interesting in its growth and production for use.

Coffee too has known long use, nor is it confined to few in its customary consumption. It stimulates individuals differently. For some it annuls sense of fatigue and fortifies for work. For others it destroys sleep and delays digestion. Its use is not to be overencouraged, but regulated it is of value under many conditions of adult life. Its moderate use is not commonly a food-abuse; its overuse is a danger to health. Its adulteration and deterioration when ground are both possible and not unusual.

Wines of all kinds are the preserved juices of fruits (commonly grapes) with flavor developed through fermentation. They usually stimulate to the degree of excitement that undoes rather than develops strength for controlled activity. They are often associated with conviviality rather than self-regulated social intercourse. Nations differ in their use and in the effect of their native wines upon themselves.

Tea is steeped, not boiled. Delicacy of flavor depends upon this, as does wholesomeness too. Boiling extracts the tannic acid that causes the ill effects of excessive tea-drinking. Varieties of tea depend upon degree of its maturity when picked, where grown, and how treated in preparation for marketing. These facts are considered in connection with its growth.

Coffee may be favorably made as a decoction (by boiling) or as an infusion (without boiling). But the coffee-pot, like the tea-pot, cannot stand ready for immediate service at any time without carrying to those that partake of its contents what no one needs and any one will suffer from drinking. Such beverages must be freshly made to be palatable or safe. The growth of coffee is part of the industry of food-production, but coffee comes from nature. Nature is the invariable, inexhaustible source of supply for the demand of humanity for physical sustenance.

Simple as tea and coffee seem as seen or tasted, viewed by science they are both found most complex. Three of their constituents especially concern those that drink them. These are tannin (astringent element); caffeine or theine (stimulating element); and the volatile oil that gives tea its flavor, and caffeol, the oil producing the aroma and flavor of coffee. Heat volatilizes these oils. Tea or coffee that stands loses flavor, and tannin is increasingly extracted. All preparation aims to decrease this and develop flavor. Coffee contains less tannin than does tea, and black tea only half that of green. Caffeine or theine and volatile oil are about the same in teas. In coffee the oil (caffeol) is developed by roasting and caffeine is somewhat decreased.

Adulterants follow all foods that are prepared without the first concern being for what foods do to persons. All substances chemically alike, much less those only physically similar, do not serve the human system similarly.

Tea is the leaf of the tea plant that is indigenous to Assam in Burma. For over fifteen hundred years it has been produced in Japan and China. Assam tea grows large but tender leaves. Its growth is luxuriant but needs protection from blights of drought and cold. A score of crops may be obtained in a season. Other kinds of tea produce three or four crops annually. Chinese tea is a hardy, coarser plant, less dependent upon soil, climate, or water supply. Its leaves are tougher, smaller, darker.

It is young leaves that are desirable for tea, hence their abundance is sought in tea-growing. The varieties of tea as purchased are but gradation of the leaves. The undeveloped bud is known as flowery pekoe. It is not usually imported here. The last developed leaves are called orange pekoe and pekoe (see below). Souchong and then congou come next. No more are used here.

Any variety of tea may be made either black or green. Japanese tea is usually green; Indian, black; Chinese, both. Green is produced by withering leaves in iron receptacles by quick heating or steaming on mats. Leaves are then rolled to release oil and heated long at low temperature. Black tea is sun-wilted, rolled, spread thin, moistened, left to ferment, then furnace-dried. The fermentation makes tannin more insoluble, so less dissolved in making tea.

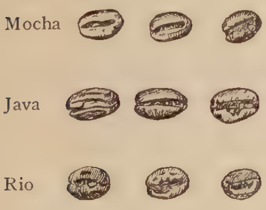
In green teas hyson is a finer variety, gunpowder a coarser. Teas often carry the name of the location of their growth, as Ceylon. Each has some distinctive characteristic due to its culture or manufacture. Teas obtainable in the United States are usually not the finest that nature produces.

Tea leaves

Coffee is the berry of a tropical tree native in Abyssinia but now widely cultivated in tropical regions. Its leaves are evergreen, its blossoms white, its berries dark and pulpy, containing two seeds each. The seeds are the coffee-beans. The tree blooms two thirds of the year. The ripe fruit is gathered three times, dried, and the seeds machine-freed. The bean is roasted to develop flavor and lessen tannin ; this also decreases caffeine. Roasted beans are brittle and easily ground.

Varieties of coffee may come from different localities, though mixtures even so named often are but different berries of the same plant. This is said to be true of Mocha and Java as bought. Brazil supplies three fourths of the coffee used here. Some comes from Porto Rico, Maracaibo, Ceylon, Mocha, Java.

Unground coffee is not as easily adulterated as ground. Some artificial berries have been made, but to-day purchasing coffee unground is thought to avoid adulteration. Into coffee the French often introduce chicory for its flavor. Elsewhere this may be used because cheaper than coffee. Chicory is the most common coffee-adulterant. Cereals, beans, peas roasted, also hulls and charcoal are other materials so used. When ground coffee is shaken in cold water, pure coffee floats, adulterants usually sink and may discolor the water. Tea suffers less adulteration than coffee. Reselling of steeped leaves mixed with fresh is the commonest deception practiced in it.



Coffee-beans

Cereal coffees are substitutes that aim to avoid tannin and the stimulation of coffee while furnishing a beverage of more or less palatability. This is sometimes secured by adding some coffee or its flavoring matter.

Tropical vegetation yields another beverage in cocoa. The cacao tree (*Theobroma cacao*) is a native of Central America. This tree has several distinctive characteristics. It blossoms throughout the year and bears fruit of all ages which successively ripens, as has been noted of other tropical plant foods. The trees grow from seeds, but do not bear until the fifth or sixth year. Then a myriad of red blossoms make a large yellow fruit (nearly 1 ft. long and ⅓ ft. wide). This is pulpy and contains from two to four dozen seeds. These are the cocoa-beans. The fruit grows on the trunks of the trees and on the main limbs, never at the end of the small branches, that could not sustain its weight.

The tree itself requires particular conditions to thrive. It needs air in plenty and light, but must be protected from the excessive direct rays of the sun. On cocoa plantations the tree is sheltered by planting taller shade trees about it. The tree itself is 14–30 ft. high and ½–1 ft. through. Fertile, protected valleys are sought for its cultivation. It grows wild under the conditions propitious for its development. Though it requires other trees to shade it, it is the tree that itself is used to support the vanilla plant that is a parasite, so grows only on trees, though this takes its sustenance from the air through its aërial roots. Cocoa and vanilla are thus cultivated together.

The history of the use of plants for food often reveals the lack of earlier communication between countries and the slow interchange of their products and customs. Cocoa was found in Mexico by Cortes, but it came to us by passing to Spain, thence to Italy, France, England, and back to America.

Branch of cocoa-tree

Chocolate was not used in England until the beginning of the eighteenth century, though it was introduced into Spain early in the sixteenth. America began the preparation of chocolate in the latter half of the eighteenth century.

The ripened fruit is gathered from the tree, opened, and the seeds removed. These are sun-dried at once or subjected to a fermentation process ("sweating"), then dried. The flavor is improved by the fermentation and the bitterness is decreased. The roasting of the cocoa-beans is preceded by separating from them foreign particles and sorting the beans according to size. Thus flavor is further developed, and the tannin present is converted into cocoa-red that colors cocoa characteristically.

The roasted beans then have their hulls cracked off and removed by winnowing. The beans themselves are next crushed and the germ removed. The cracked beans known as *cocoa-nibs* are prepared for a beverage and other uses noted below. The *hulls* are sometimes boiled for a beverage, but are more usually employed in adulterating cocoa or for cattle-food.

Chocolate is the product of grinding the cocoa-nibs (usually several times). This is then semiliquid and can be run into molds. It hardens as it cools and is unsweetened chocolate. When sugar or any flavoring, as vanilla or cinnamon, is added to chocolate, it is introduced while chocolate is in the paste state. The fat present (50%) can be partly removed under pressure. *Cocoa butter* is the fat so removed. Its use is largely for medical purposes and confectionery coatings.

Cocoa in its purest form is chocolate with some fat removed. This makes its powdered form possible. Starch is added to keep it so.

Cocoa-beans

The use of cocoa has greatly increased of late years. This is usually attributed to its food value, that is real, though probably not all that is always claimed for it.

Cocoa contains theobromine (similar to caffeine or theine), also a little caffeine. But its stimulating effect is slight, far less than that of coffee or tea, as is also its retardation of digestion, since the tannin in raw cocoa-beans is transformed in roasting. Cocoa as a beverage has much less fat than the bean. This varies with different preparations. When pure cocoa is not digestible, it is due to the fat. Not every one can digest fat easily. Otherwise cocoa is very digestible.

Though cocoa has the nourishing food-constituents, these are insufficient for much nutriment in the quantity in which it is used as a beverage. Made with milk there is more. Cocoa is not, however, a negligible factor in the diet, as are tea and coffee in respect to nourishment. The fact that cocoa as marketed contains starch makes it important that it be cooked.

BREAKFAST COCOAS (Selected from Olsen's "Pure Foods")

Ash	Water	Theobromine	% in	Fat	Starch, etc.	Protein
5.54	4.27	1.02	Huyler	34.04	18.7	17.29
4.7	6.02	1.28	Baker	29.3	14.66	19.53
8.19	4.53	.69	Van Houten	29.78	29.96	17.03
5.43	3.2	—	Lowney	23.	17.68	24.88

CHOCOLATE IN DIFFERENT FORMS

Ash	Water	Caffeine	Theobromine	% in	Fat	Sugar	Starch	Fiber	Protein
3.	3.	.4	1.	Pure	50.	—	—	3.	12.
1.	10.6	.1	.4	Sweet	16.7	57.	9.2	1.	4.
.3	10.6	.04	.1	Creams	5.	79.4	2.76	.3	1.2

It is the pure chocolate that is supposed to be used in cooking; but often it is mixed with sugar and cocoa butter.

Food signifies sustenance. Beverages stimulate principally. The refreshment they afford may have purpose in adult life when those are used that neither excite nor depress. Such effects injure health. The nutritive value of food-substances needs to be estimated for foods as consumed. Beverages contain much water. This diminishes the proportions of their constituents. Since only the liquid is used, only what is soluble in water is consumed. Protein in tea is insoluble.

TEA — COFFEE — COCOA — CHOCOLATE AS PRODUCED

	PROTEIN	% IN	FIBER	SUGAR	FAT	ASH	TANNIN	THEINE
(Insoluble)	37.33	Tea (original)	10.44			4.97	12.91	3.3
	37.43	Tea (green)	10.06			4.92	10.64	3.2
	38.9	Tea (black)	10.07			4.93	4.89	3.3
WATER							TANNIN AND CAFFEINE	
11.23	12.07	Coffee (raw)		.66	12.27	3.92		1.21
1.15	13.98	Coffee (roasted)		8.55	14.48	4.75		1.24
				STARCH				THEOBROMINE
3.	12.	Cocoa (nibs)	2.5	27.5	50.	3.5	.5	1.
—	—	Cocoa	5.02	—	32.52	4.2	—	—
3.09	—	Chocolate	2.63	—	49.81	3.08	—	—

BEVERAGES AS USED (*1 pint water to be added to quantities indicated*)

WATER	PROTEIN	% IN	CARBOHYDRATES (sugar, sugar-fiber)	FAT	TANNIN	CAFFEINE
99.5	.2	Tea (½ oz.)	.6		(See statement, p. 55)	
98.9	.2	Coffee (1 oz.)	.7			
99.5	.2	Cereal (½ oz.)	1.4		(No tannin nor caffeine)	
99.5	.2	Parched corn (1.6 oz.)	.5			
99.7	.3	Oatmeal water (1 oz.)	.3			
		Cocoa (½ oz.)				
97.1	.6	With water	1.1	.9		
84.5	3.8	With milk	6.	4.7		
90.5	3.4	Milk (skimmed)	5.1	.3		

(Arranged from Snyder's "Human Foods")

Sugar is another product of vegetation. It is consumed in various forms in large quantities. The reported sugar-consumption in 1895 gives for England 86 lb. per capita, and for the United States 64 lb., and 80 lb. in 1912.

Sugar-cane until recently yielded the sugar consumed as food. Now sugar-beets supply an increasing proportion of that used. Substitute sirups are also taking the place of cane-sugar in manufactured foods.

Production of sugar from sugar-cane consists in cutting and pressing the cane to secure the juice. This is purified and evaporated. The sugar then crystallizes. Such sugar is brown. The sirup left is molasses. When sugar is made from beets, the sugar is dissolved from the beets after they have been chopped fine.

Refining raw sugar is accomplished by a series of processes that remove all impurities, reëvaporate it and recrystallize the sugar in purer form. Slight difference in degree of coarseness of sugar is produced in the crystallizing of the grains. But powdered sugar is ground usually from that broken in cutting loaf sugar for table use. Its seeming lack of sweetness is due to its fine division, not necessarily to adulteration. Sugar that entirely dissolves is probably pure. If starch were added it would remain insoluble.

Glucose is a sirup commercially produced from corn and used as a sugar substitute in made-foods, especially candies. It should be wholesome if pure and carefully made. Glucose when pure is a predigested food, that is, is ready for assimilation as consumed. But all digestive processes performed for the body outside of it do not always aid it, even though it is not known exactly why they do not. The body to be properly fed seems to need to do its own work of digestion.

SUMMARY **VEGETATION**

Vegetation includes all plant life and is the source of all plant foods. Tropical vegetation shows characteristics that distinguish it from that of the temperate zone. Tropical growth is luxuriant; the fruit is abundant and usually fragrant and luscious; the crops are many a year; all ages grow together and ripen successively. The inclusion of tropical products in the diet of colder climates is not simply bringing foods at seasons that they would not grow in any but a tropical region, but is bringing foods of ever new growth almost continuously. The tropics also supply some foods that other regions cannot; for example, many spices.

Needs of vegetation itself are those common to life, for vegetation is living. It is also working. For living it needs itself water, air, and food suited to its uses. Plants make in themselves from their own foods, that would not nourish animals and humankind, substances that serve as human foods and for animals too. This is only part, though a most significant part, of the work that vegetation does through its life-activity.

Supplies of food from vegetation are most varied, as they include grains, vegetables, fruits, spices, nuts, leaves and seeds serving as beverages, and seeds producing oil. These include all food-constituents needed for the life of humankind, though an exclusively vegetable diet is not advised generally by food-scientists. It is, however, upon vegetation alone that reliance must be placed for starch, and mainly for sugar too. Protein and mineral matter it furnishes in common with animal life, and is beginning to rival animal life as a source for fats, since the consumption of vegetable oils is greatly increasing.

Humanity not only uses vegetation for food and other living-needs but also learns much from it concerning nature's workings. Through this it ever finds new aid possible.

All living matter requires for life, food, air, water. Thirst, hunger, suffocation, result from lack of water, food, air. Life ceases when living things are deprived of air. Lack of water can be endured less long than lack of food. But the greater effort required to secure food makes it seem the most important need of life. Air, water, food, are all essential; air continuously, water and food, periodically.

Vegetation supplies plant food and purifies the atmosphere. Its production of plant food is no less significant to human life than its effect upon the air-supply. Plants live as do animals and humanity. All breathe alike in that they take in air and give out carbon dioxid (CO_2) both day and night. This process of living is called respiration.

In the other processes of living, plants and animals differ more. But in the internal activities of physical living, animals and humanity are very similar, though their food differs in kind. The food of plants differs from that of both. Plants themselves become the food of both animals and humankind. Foods are of use to living organisms only as they unite with the oxygen of the air breathed in during respiration. This combining of food and oxygen is part of the process of nutrition; that is, the physiological utilization of food.

Green plants use as food the carbon of the carbon dioxid that is breathed out by all living things. The green coloring matter of plants seen in leaves is called chlorophyll. Through the agency of chlorophyll green plants have the power *in the presence of sunlight* to break up carbon dioxid, use the carbon as food, and return the oxygen it contains to the atmosphere. But for this function of green vegetation the carbon dioxide breathed out by the living of humanity, animals and plants would render the air unable to support life.

Carbon of carbon dioxid taken for food by plants not only purifies the atmosphere but is transformed from carbon that animals and humankind cannot use directly into carbohydrates in the plants which both animals and humankind need and secure in consuming plants. Oils in plants are similarly produced.

Mineral matter plants obtain from the soil through their roots. They associate these in themselves with the other substances of which plants are constituted. It is thus the mineral salts are passed from inorganic (non-living) nature through organic (living) nature in plants to animals and humankind. Such salts are necessary for bone-building, also for such regulation of density of the liquids of the body as will insure their transfusion through body-tissues, which is the need in body-living.

Though many of the salts used by the body can be produced in isolation from plant or other living substance, the body cannot make the same use of them when so made. The mineral salts of fruits are usable by the body and most serviceable to it as they are taken in association with organic matter. It is thus that they exist in vegetables and fruits, in which living plants have grown them into association with the organic substances.

Drugs of the same chemical composition as such salts or any artificial preparations of these are not always so assuredly absorbed. What fruits naturally do when taken into the body to keep it in health cannot be artificially effected. Why this is so is not fully known, but the fact is increasingly recognized and is one cause for increased fruit-consumption.

Protein, the food-constituent that carries nitrogen — an element essential to the life of every living cell — from nature to animals and humankind is built up by plants from compounds plants take from the soil in their living. Leguminous plants do likewise with free nitrogen from the atmosphere.

The effects of plant-activity in the working of nature are significant to all life upon the earth. Plant-activity effects production of plant foods in which simple substances are naturally made into the more complex that alone can nourish the higher forms of physical life, namely, animals and humankind. It effects purification of the atmosphere by removing carbon dioxid from it and returning to it the oxygen from the decomposed carbon dioxid and by taking from the atmosphere some of its free nitrogen through the agency of leguminous plants and transforming this into nitrogen compounds of the soil. It also effects construction of the plant protein from the nitrogen compounds of the soil and carries the mineral salts from the soil into association with organic matter, thus bringing these salts into usable form in human plant-foods. These effects of plant-activity alter favorably the air breathed and construct substances usable as human foods.

Another group of its effects is scarcely less important. As vegetation grows it needs moisture. Where forests have been depleted, the water they would use passes to the streams, that may then overflow, damaging the life they reach instead of serving to increase its security by fertility and an abundant water-supply. Forests modify all wind-effects and break the lower currents of air so that their control is largely determined by whether there are forests standing as a protection to life.

The life-activity of green vegetation in adding oxygen to the air-supply makes life-invigorating the atmosphere of forest regions, particularly those that are evergreen. The currents of air by movement pass some of this fresher air to congested localities. Parks, trees, and gardens in town serve the same purpose there as the forests do in the country at large. Plants in rooms perform a like service *during sunlight.*

Since bacteria have been known as the cause of some diseases, they have been commonly regarded as foes to human life. So they may prove to be if of disease-producing types or even if not, when they are consumed in large quantities. This is invariably the case when underprotected or overkept food is eaten, whether it be salads, milk, ice-cream, preserved food, water, or any easily contaminated substance that humanity consumes. But some bacteria there are which play a friendly rôle in nature by helping in production of foods that nourish humanity.

Dangers from bacteria can be averted when understood. Dust is bacteria-laden, hence the necessity of protecting from dust everything to be eaten, worn, or otherwise used by humanity. If the air breathed carries disease-germs it may cause disease. The air-supply needs therefore to be pure, free not only from excess of carbon dioxid but also from such bacteria as can harm humankind. Tuberculosis is spread by dried dust carrying the germs cast off by those diseased. Bacteria thrive in the soil many inches deep. The plant food-supply needs therefore to be soil-free as used. Water in passing through soil may take with it what soil contains. If sewage drains through to the water-supply, the water may contain the bacteria that may infest the intestinal tract. That of typhoid fever is one of these, so is borne by water to humanity. Only thoroughly boiled, filtered, or purified water is assuredly germ-free.

Some chemicals prevent bacterial growth, but they would usually also render a substance unfit for use as a food. Heat fortunately is also a destroyer of bacterial vitality. This makes cooking of importance in obtaining germ-free food. But all bacteria are not destroyed by the temperatures non-destructive to food, and some grow without air, so preserved foods can contain many bacteria, though freed of putrefactive bacteria.

It is only in modern times that bacteria have themselves become known, though the effects of their living have been experienced probably always and recognized more or less since ancient times. Bacteria abound everywhere in air, water, soil. Wherever they are they are doing something. They break down the substances they live on. Human beings are the host upon which disease-bacteria subsist.

The work of non-disease bacteria in nature is real and of unique value, as they have a necessary part in life, not shared by other organisms or done by other agencies. Bacteria are living organisms, so require the conditions necessary to their life in order to live; nitrogenous food, moisture and usually air.

Bacteria utilize the nitrogenous substances that are the waste-products of the living of higher forms of physical life and that are not directly usable by vegetation. These they break up into simpler nitrogen compounds that plants can use. They also free some nitrogen to the atmosphere. But for such bacterial activity, nitrogen in the forms needed everywhere in life would not be available.

Until the microscope was invented bacteria were not seen. They are such minute organisms that they have to be enlarged (some, 1200 times) to be visible to the human eye. Though not wholly like non-microscopic plants, they have more plant characteristics than animal. The use of bacteria to both plants and animals is their life-activity. This makes the products of living of animals of use to plants that in turn themselves make food for animals and humankind.

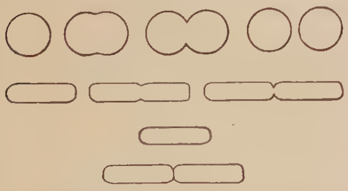
Bacteria in drop of milk: multiplication in 12 hrs. (After Russell)

When conditions are not favorable to bacterial life some bacteria die, others pass into resistant, resting forms. These are called spores. They are not easily destroyed, therefore may remain alive in water or food or air even after subjected to great heat. When favorable conditions for bacterial growth are reëstablished, spores become active, change back into the growing form of bacteria, and these then multiply.

Seeds of plants are not like bacterial spores. The two should not be confused. Seeds are more than alive forms that return to a growing state under reinstatement of favorable conditions. Seeds bring forth new plants. Spores are bacteria that remain alive when deprived of what they need to grow. Spores form under conditions of destitution; seeds under conditions favorable to growth. Bacteria reproduce in general by the subdividing of the bacterial organism itself and the repeated redividing of the subdivisions. See diagrams below.

Humankind, animals, plants, bacteria, are all living organisms. Their processes of living, growing, reproducing, and readjusting themselves differ somewhat, but they all interwork.

Organisms are forms of life that, in addition to existing, are somewhat active and change somewhat. They live, grow, reproduce their kind similarly, but tend to change slightly in response to whatever differs in their action. It is living and working that provides food to sustain life. It is through reproduction that generation follows generation, and that the species or race lives on. It is through a new response in action that any advance occurs.



Reproduction by fission. (After Conn)

The products of living of different types of organisms are alike in some respects and unlike in others. Complex products cast off by one organism as of no further use for it are broken down into simpler forms by some other organism, and by another are built up anew into a newly combined complex substance usable by still others. Waste products of living are usually broken down. What is consumed is built up into something new or used up in something done as work.

In their functions, that is, what they do in nature through their living, organisms of different types are less alike even than in their products of living. Their functions are therefore very important. If one fails in what it alone can do, others or all are hindered and delayed, or may even be destroyed.

Bacteria carry nitrogen from the complex forms of nitrogenous waste products of animal life to the simpler compounds serving plants as food.

Plants build nitrogen into protein — the *building* food of animal life — by combining it with other elements. Plants decompose the carbon dioxid of expired air and so unite the carbon with hydrogen and oxygen as to construct sugar, starch, cellulose, oil, — carbohydrates and fats, — the *heat-energy* foods of animal life. Plants also carry the salts of minerals into combination with organic substances, which is the only form in which they are thoroughly assimilable by animal organisms. Mineral salts are the *regulating* food-elements for animal life; they build somewhat, too.

Animals make no really new kind of food-substance. They do, however, so transform some substances as to make them more readily or fully digested by humankind. Vegetable protein is incased in cellulose (woody fiber). This makes it less fully available for use than animal protein.

The work of food-production as a process of nature is progressive, but moves ever in an interworking cycle that conserves all products of living as well as constructs all used for food. In general function in nature bacteria decompose, plants construct, animals transform. Human beings give off carbon dioxid that plants use and nitrogenous waste that bacteria use. But in these nothing new is contributed, as they are also the products of living of all animal life.

The part humanity uniquely performs in food-production is mainly mental in the practical and scientific conduct of living. Human work enters into food-cultivation, care, selection, preparation for humankind, animals, plants, bacteria. Because of humanity's greater physical dexterity and elasticity in developing new powers, it is humanity that learns how nature interworks and can be worked together so as to advance race-life and extend natural resources and their utilization.

The foods of bacteria, plants, animals, humankind, which in themselves differ, contain the same chemical elements variously combined and in varying quantities. The chief of these are nitrogen, carbon, oxygen, hydrogen. There are many others of great importance too, though used in much smaller amounts. Such are calcium, sodium, potassium, sulphur, phosphorus. What these do as substances alone is different from what they do when combined. Different combinations also act differently. How these elements are brought together determines the constitution of the foods or organisms they compose. Air, sunlight, soil, water, have part in effecting these combinations. Plants need sunlight to get carbon from carbon dioxid; bacteria leave the nitrogen compounds in the soil; plants find them there; water aids in the transfusion of food as food is being transformed for assimilation in the body.

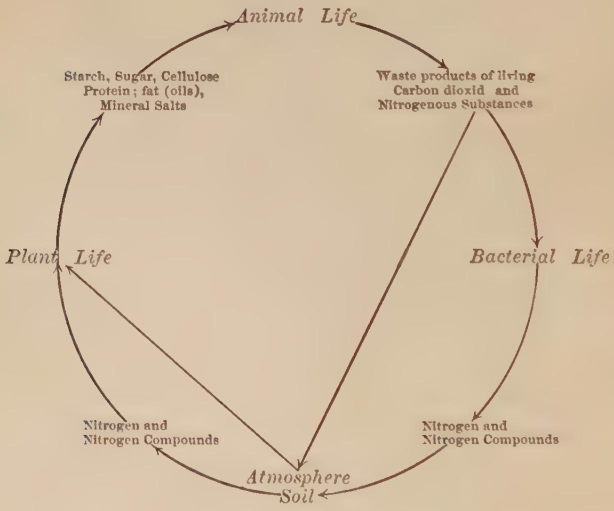
FOOD-CYCLE BACTERIA — PLANTS — ANIMALS — HUMANKIND

TAKE FROM NATURE		GIVE TO NATURE
Air, water, food (vegetable and animal)	*Humankind*	Carbon dioxid and nitrogenous waste products
Air, water, food (vegetable)	*Animals*	Carbon dioxid and nitrogenous waste products, and themselves as human food
Air, water, carbon, nitrogen and its compounds, and mineral salts	*Plants*	Carbon dioxid and themselves as animal and human food
Air, water, nitrogenous waste products	*Bacteria*	Nitrogen and nitrogen compounds

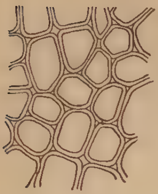
Carbon passes through the atmosphere to plants; nitrogen (generally) through the soil.

Oxygen unites with food in chemical action from which heat evolves. This is the source of body-energy and heat.

Find on diagram below as many of above facts as possible.



CELLULOSE AND STARCH IN PLANT CELLS



Plant cell

Cellular structure (After König)

Potato

Transverse section. (After Cowden and Bussard)

Potato starch in cellular cells

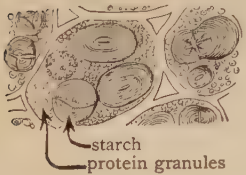
(After König)

Cut cross-sections of vegetables and fruits, as beet, parsnip, onion, cucumber, tomato, orange, lemon.

Draw the lines that are visible. See thin sections under microscope whenever possible.

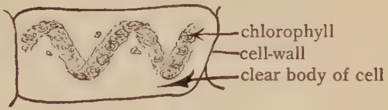
Look at cross-sections of plant stems and of woods.

PEA CELLS



(After Sachs)

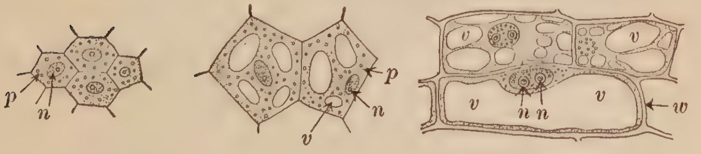
SPIROGYRA



Chlorophyll: Green coloring matter in vegetation

(After Green)

DEVELOPING VEGETABLE CELLS

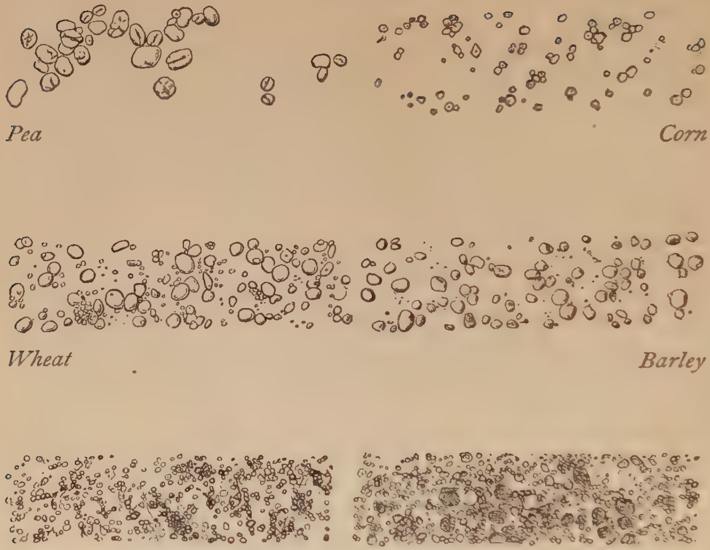


Very young *Older cells* *Adult vegetable cells*

(*p*, protoplasm; *n*, nucleus; *v*, vacuole; *w*, cell-wall — much magnified)

STARCH GRAINS IN SEEDS

STARCH



Pea *Corn*

Wheat *Barley*

Rice *Oats*

Starch in Vegetable Foods

Rice	79.4	2.5	Melons
Rye Flour	78.7	6.2	Cabbages
Buckwheat Flour	77.6	6.0	Turnips
Wheat Flour	75.6	10.1	Carrots
Graham Flour	71.8	14.3	Apples
Corn Meal	71.	16.3	Pears
Oatmeal	68.1	21.3	Potatoes
Beans	57.4	21.1	Sweet Potatoes
Wheat Bread	55.5	23.3	Bananas

(From Atwater's Analyses)

IN 1913

Wheat	250,133,333 bushels	12% *less* than in 1912	In Argentina, Australia, New Zealand
Rice	82,544,000,000 pounds	Slightly *less* than in 1912	In Spain, Italy, United States, India, Japan, Egypt
Sugar (Raw beet)	8,960,000 short tons	2.3% *more* than in 1912	In Russia, Roumania, Germany, Australia, Belgium, Denmark, France, Hungary, Italy, Netherlands, Switzerland, United States
Corn	10,260,000 acres	8.4% *more* than in 1912	In Argentina
Oats	87,500,000 bushels	33.1% *less* than in 1912	In Argentina, New Zealand
Flax	2,723,000 acres	21.2% *less* than in 1912	In India

(Report to the United States Department of Agriculture from the International Institute of Agriculture at Rome, Italy)

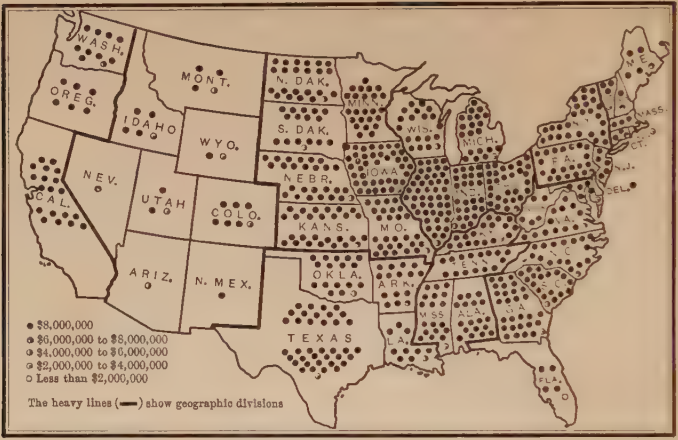
Make a comparative table of the above products for 1912 and 1913.

Which countries produced less of these in 1913 than in 1912?

Ceres

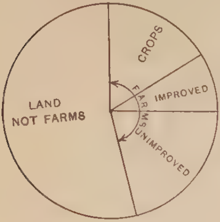
CROPS AND LAND DISTRIBUTION UNITED STATES IN 1909–1910

VALUE OF ALL CROPS IN 1909 CROPS; BY STATES



(From the Thirteenth Census of the United States, 1910)

LAND AREA IMPROVED LAND



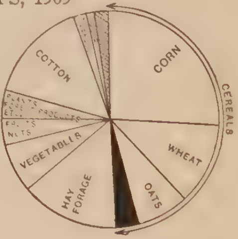
In 1899

In 1909

DISTRIBUTION OF ALL CROPS, 1909

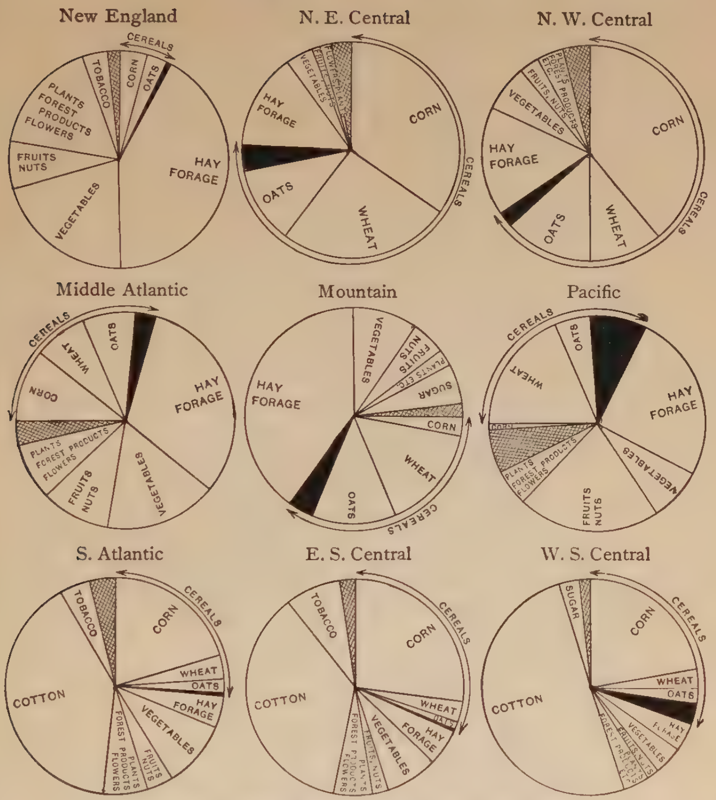
▨ Other crops

■ Other cereals



U.S.A.—1909

DISTRIBUTION OF ALL CROPS



(From the Thirteenth Census of the United States, 1910)

Other crops ▨ ■ Other cereals

Compare with maps on pp. 18, 19, 49.

Which divisions have the same chief products?

Write a list of all the products named above. After each product write the divisions producing it, in the order of the quantity produced.

Nature is the source of the Food Supply.
The Farm is the center of Food-Production.

Humankind supplies the workers.
Humanity is the consumer.

What is needed for nourishment should be cultivated, marketed, selected, consumed.

Plant foods will sustain life. Many digest slowly.
Animal foods digest more fully but are not serviceable alone.

The value of plants and animals as Human Food is increased by Plant and Animal Food being used together.

Food repairs the body, supplies energy for activity, and body-heat.

American Oyster Fleet

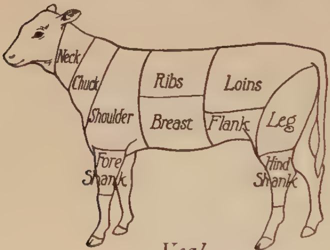
ANIMAL LIFE AND ANIMAL FOODS

French Oyster Fleet

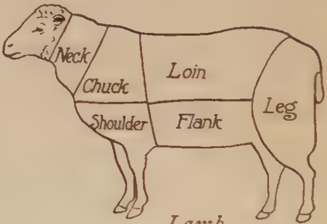
Animal foods are expensive and contain much refuse.
Their extractives tend to overstimulate.

Protein, fat, mineral matter, water are the constituents of animal food.
Excess of protein food is a health-menace.

Animal health and sanitary environment for animals are the necessary forerunners of wholesomeness of animal food.



Veal



Lamb

Chicago is the meat center of the United States.
The workers employed number 40,000; 200,000 form the packing population; 1200 farmers come daily to the stockyards with cattle, sheep, hogs.
Live stock worth over $1,000,000 are received every day.

1912		1860
2,650,000	Cattle	42,000
500,000	Calves	——
6,000,000	Sheep	——
8,000,000	Hogs	00,000

$390,000,000 worth of live stock is sold yearly at the Chicago yards.
$300,000,000 of this value is raw material.
$90,000,000 is labor.
$300,000,000 capitalization covers the Chicago plants and their plants in other American and foreign cities.

(Data used from Report of Chicago Association of Commerce.)

Animals used for food range from 3 to 8 years of age. (Steer from 4 to 5 years gives the best beef.) The time, care, food that animals require and the difficulty of the preservation of meat make it essentially a more expensive food than those that take less time, attention, care, and expenditure to produce. In general, food from the vegetable kingdom costs less than from the animal. The vegetable kingdom provides the food for the animal. It is, however, the less expensive foods from the vegetable kingdom which are used as foods by animals, that in turn become food for humankind.

Animals, in being more subject to disease than plants, do not supply so large a proportion of food from those produced for food. To this must be added the further facts that all of the animal is not edible (about $\frac{1}{5}$ is not) and all parts do not provide equally desirable food. The fore quarters of beef, which are inferior as food to the hind quarters, weigh $\frac{1}{7}$ more than the hind quarters. Together these facts make meat expensive, especially the more tender parts. Conditions of commerce still further affect the cost of such foods in very appreciable ways.

Animal food has worked over in it the constituents of the plants animals eat. These thus become available as human food. The edible portions of animal food are more fully digestible than plant foods edible for humankind. Ninety-five per cent of animal protein is digested; only 85% of vegetable. This is due more to the arrangement of the latter within vegetable fiber than to the chemical difference in plant and animal protein. This, and the fact that animal food contains more protein, makes the excess of such protein in human diet more possible and probable from meat than vegetables. In this respect animal food is concentrated food. This makes little of it advisable. Expense makes but little of it generally available.

Animals live; they need provisions for life—air, water, food. All animals need these. All do not, however, eat the same food. Science has studied the food-needs of work-animals and food-animals, also the conditions that foster the effectiveness of each; these differ. Animals strengthened for work and toughened by it and exposure are thereby rendered undesirable for food.

Work-animals need health. But for food-animals health is indispensable. Ill animals, even if not diseased in ways to cause the same disease in persons, are unfit food. Human health cannot be promoted by diseased food of any kind. Human health is the purpose of human food. Wholesomeness of animals themselves, of their environment, of those that care for them, market, and prepare them, will alone produce wholesome food and physical wholesomeness through food.

Food-animals that have died, instead of being killed while in health, are unfit food, for death means that something unfavorable to living interfered with the life of such animals. Only tissue that could live is fit food for living humanity. Animals in health, killed and preserved in a state of soundness without preservatives destructive to their purpose as human food, furnish health-giving animal tissue as meats.

Products of animal life also serve as human foods. Their quality is no less significant than that of meats. This is affected too by the processes of living of the animals producing dairy products. Milk is safe only from wholesome animals. It is clean only as it is kept so. The living conditions and food of animals determine the value of their products as human foods. Poor animals poorly cared for or poorly fed cannot but supply poor, if not dangerous, food.

The body of animals is greatly affected by the living of the animals. The quality and quantity of their foods, the air they breathe, the water they drink, the work they do, the exposure they suffer, the health they have, the age they are, determine the desirability of animal foods, both as to nutrition and palatability.

The flesh of some very young animals, as veal, is too compact in fiber to be readily separated, so is not easily reached by digestive juices. The lack of fatty tissue in these increases this compactness of fiber. In very old animals fiber is toughened through living, and fatty tissue has usually become excessive. For these reasons, within the age-range of desirable animal food — 3 to 8 years — 4 to 5 gives the best food. The substances present in the young animal may also differ somewhat from those of the older.

The location of the different parts of the animal used for food determines their exposure and exercise. Neck and legs are toughened by their natural use. The interior of the animal, especially under the backbone from the ribs toward the hind legs, is tender, because protected and little exercised. Outside cuts of meat are 2½ times as tough as those from the interior. In young animals this difference is even greater.

Since flavor is developed by exercise of muscle, and tenderness by lack of it, the choice of parts even within the same animal is always somewhat of a choice between flavor and tenderness. Differences of texture and flavor require different treatment to secure from all parts of animals the nourishment they can yield. Expensive, interior, tender cuts of meat have less flavor ; it is cooking that develops flavor in these. Inexpensive, exterior, tough cuts have developed flavor through exercise, but cooking must be relied upon to make them tender.

Foods designated as meats are beef and veal, mutton and lamb, pork, fresh, canned, or otherwise preserved. But poultry, game, fish, eggs, and milk are also animal foods.

Beef is about $\frac{1}{2}$ water. When there is little fat there is more water. Refuse is usually $\frac{1}{10}$ +. Protein ranges from $\frac{1}{6}$ to $\frac{1}{5}$; fat is about the same; mineral matter is $\frac{1}{100}$ +. Beef is less tender than mutton or pork but is most digestible, due probably somewhat to its extractives.

Veal (young beef) contains, like all young animals, less fat than those more mature, so less than beef itself. (What is the food-constituent that increases with the growth of maturing of plants? When old plants and animals are eaten, what is the function of the constituents that increase with maturity?) Veal is less digestible than beef because of lack of flavor and compactness of fiber.

Mutton contains less water than beef, therefore more fat. It averages 8% less water, 2% less protein, and $\frac{1}{2}$ as much more fat. It thus supplies more energy. Mutton is generally considered as digestible as beef. But to those to whom fat is not readily digestible, or who do not like the flavor of mutton, it is less palatable. Its flavor is partly due to its fat and not wholly to its extractives, as in beef. Mutton contains fewer extractives than beef. This fact increases its value when extractives must be avoided, as may be necessary in illness.

Lamb (young mutton) varies from mutton as veal from beef. The leg has the least fat and most protein. The chuck reverses this. (What has it?) Lamb is more palatable than mutton, due to more delicate flavor, and more digestible, due to decreased fat. Extractives increase with age and exercise.

Preserved meats when smoked lose no nutrients. Smoke not only preserves but adds flavor to meats. (See p. 149.)

Pork, as is generally known, contains more fat than other meats, so less water (10–20% less) and relatively less protein. Usually in pork, especially bacon, there is somewhat less waste than in other meats. Ham is lean pork; bacon is fat pork.

Bacon is about $\frac{1}{2}$ fat. It contains twice as much fat as ham, three times as much as other meats, and only $\frac{1}{3}$ less than butter. It is $\frac{1}{10}$–$\frac{3}{10}$ protein and $\frac{2}{5}$–$\frac{4}{5}$ fat. Bacon is most digestible; only butter and cream rival it in digestibility among fats.

Lard is fat from pork. Leaf-lard is from the fat accumulated inside the lower back part of the animal-body. It is the best lard. Lard is combined with other fats in artificial lards.

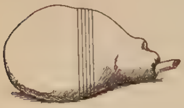
Prepared meats, as sausages and minced meats, are compounds of mixed, chopped meats of different kinds. They may contain as much protein and more fat than the meats naturally do. But their composition in this and all other respects depends upon the mixture. When any vegetable substances are added, this is expected to be noted on the label.

Meats, fresh, preserved, or prepared, differ in use to the body according to their composition and condition. Difference in flavor is somewhat due to the food of the animal. This, as well as the general characteristics of meats, may therefore be somewhat controlled by the feeding during the early growth of the animal. Milk-fed chickens are more tender than others.

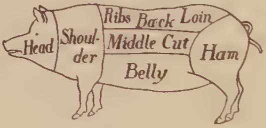
When animals are killed their flesh is tender, soft, juicy. It immediately stiffens, toughens, hardens. This is called rigor mortis; it passes. The flesh is then again soft and tender and flavor has developed. It is in this third condition that meat is usually eaten. But as this change is due to the onset of decomposition (in which lactic acid forms and softens the connective tissue, as would mild vinegar), meat is eaten more promptly after slaughtering wherever heat requires that it be not kept long.

In general, the animal is cut both lengthwise and crosswise, therefore into four quarters, two fore and two hind. The fore and hind quarters differ in some respects in very marked ways. Inspection of the diagrams (p. 90) and of meat itself shows this. The fact that the form of the skeleton of the animal distributes the bones differently through the different parts of the animal, and the further fact that the muscles of the animal are so differently used in different parts, make the existing differences in the cuts and in their quality a natural consequence of these facts. Purchase and preparation of meat are both controlled by these differences in the cuts.

Difference in cuts of meat and its significance should be understood. Such knowledge guides buying and directs cooking of meat. The flesh of animals above and toward the back is finer and firmer than that below and toward the front.



Ham



Pork

Leg of lamb
(see p. 99)

Fore quarters (weigh in beef about 310 lb.) are cut into:
Ribs, chuck, neck, shoulder, shank, brisket, plate, navel. (See p. 91.)
Coarse, inferior, less desirable. Ribs are the best fore-quarter cuts.
In general, fore quarters, except the ribs, are used in the main for stews and soups, canning and corning, chopped or mince meat.
Hind quarters (weigh in beef about 268 lb.) are cut into:
Loin, rump, round, flank, shank. (See p. 91.)
Fine, firm, and with the ribs of the fore quarters are the best cuts of meat.
In general, hind quarters are less fat and used as steaks, roasts, stews, soups.
Fore quarters cost from 5 to 25+ cents a pound. Hind, from 12 to 40.
(The quantity of each as well as the quality affects this range in price.)
The chuck, plate, brisket, flank, keep less well than do other cuts.

In *Carving*, the grain of the meat, that is, the way the fibers run, is the primary fact to be regarded. Short fibers are more tender than long ones, because short they are more fully exposed to the digestive juices. *Cutting fibers across* and masticating thoroughly increase digestibility of meat.

Location of bones also requires attention, *that the bones may be avoided* and the meat loosened from them in carving. Hence the necessity of a general but clear idea of the relation of the cuts of meat to the skeleton and the muscles.

In all animals the bones and muscles are in similar positions and similar in character. The general large cuts of the animal for the market differ as in the diagrams on pp. 82, 88, 90. The special cuts of these into the small cuts for the household are similar. The steaks of beef become *chops* or *cutlets*, thus:


Rib


French


Loin


Round bone


Blade

Steaks from beef are the cuts relatively free from bones and of such texture as to be palatable when cut comparatively thin (1″–1½″) and cooked quickly, as in broiling or roasting. (See p. 92.)

Roasts are larger quantities of the same cuts or ribs in beef; in mutton and pork they are legs and shoulders. (See p. 93.)

Turn the next page into a roll and look at cuts on pp. 92–93, with cuts on pp. 90–91. Where in the animal do you find these?

See steaks, chops, cutlets, roasts of different kinds at home and in shops.

Look in steaks for bones Straight T-shaped | T ▽ O Triangular Round and modifications of these, also amount of fat. Draw the steaks. Name each. Then compare with book.

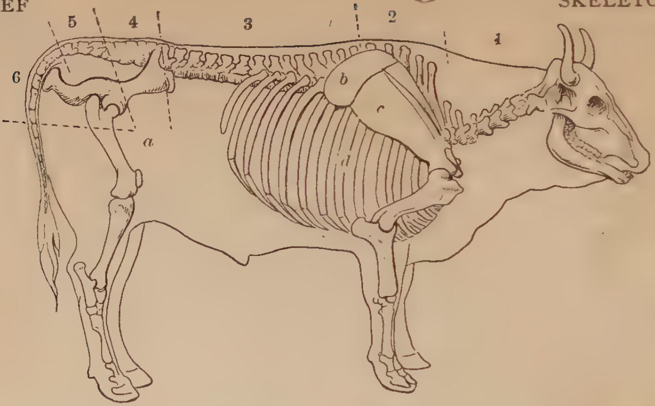
Reread pp. 85–86, and inspect meat and muscles of animals (diagram, p. 90), then decide carving and indicate with lines on your drawings.

ANIMAL DIAGRAMS

SKELETON — MUSCLES — CUTS

BEEF

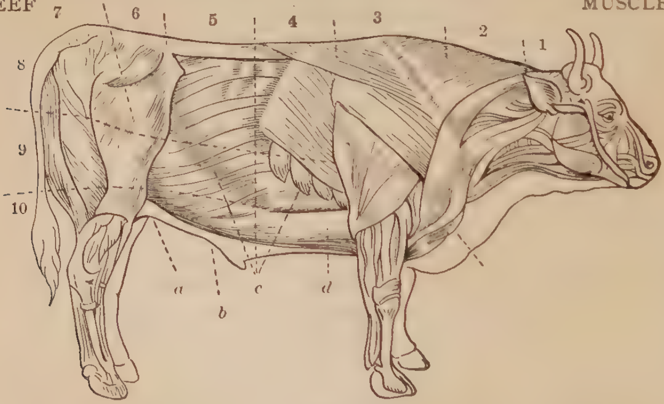
SKELETON



1 — neck
2 — chuck ribs (6)
3 — prime ribs (7) and loin
4 — thick or hip sirloin
5*a* — top of rump
6*a* — aitchbone or rump piece
b — cartilage
c — shoulder blade
d — cross ribs

BEEF

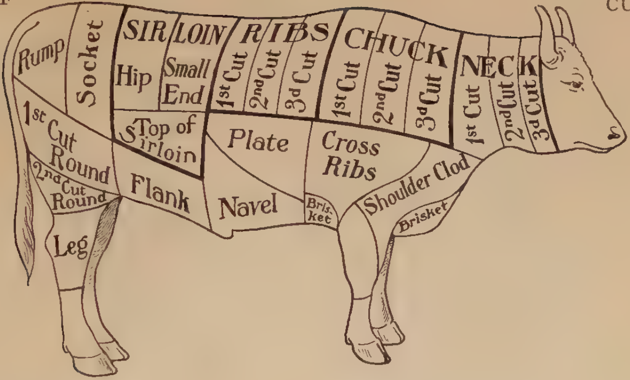
MUSCLES



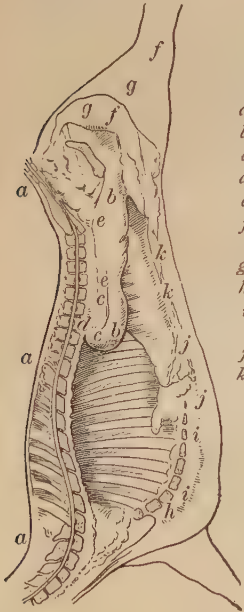
1 — head
2 — neck
3 — chuck ribs and shoulder blade
4 — prime ribs (7)
5 — loin
6 — thick sirloin
7–8 — rump piece (in New York)
8 — aitchbone
9 — round
10 — leg
a — top of sirloin
b — flank
c — plate
d — brisket

(Redrawn from Maria Parloa's "Home Economics," by permission of The Century Co.)

BEEF CUTS

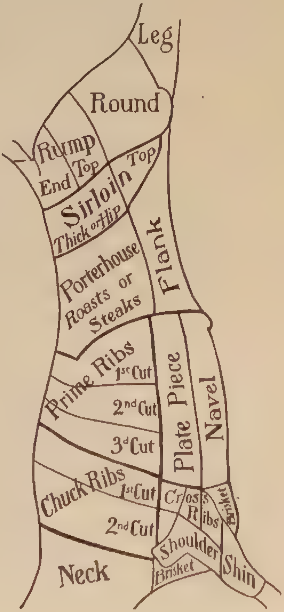


SIDE OF BEEF

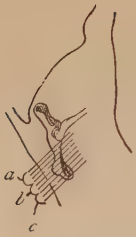


a — spine
b — suet
c — kidney
d — tenderloin (thin)
e — tenderloin (thick)
f — round (top or inside)
g — round (best part)
h — sternum
i — brisket (thick end)
j — brisket (thin end)
k — flank

NEW YORK CUTS



STEAK—CUTS

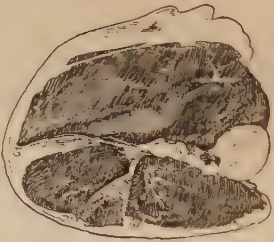


Method of cutting sirloin steaks

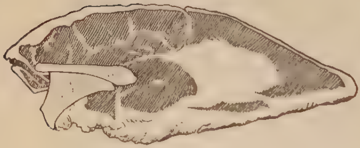
a—3 round-bone—poorest
b—3 flat-bone—better
c—3 hip-bone—best
(largest tenderloin)

Chuck steak

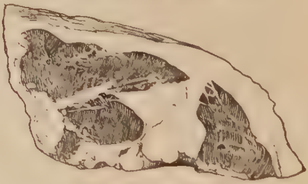
Round-bone steak



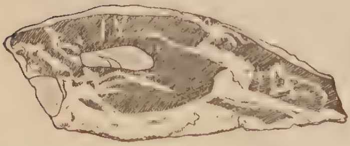
Top and bottom round steak



Flat-bone steak



Porterhouse steak

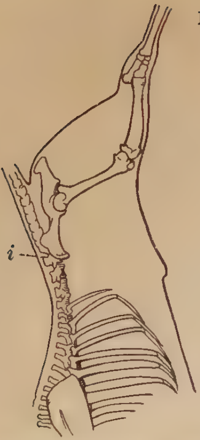


Hip-bone steak

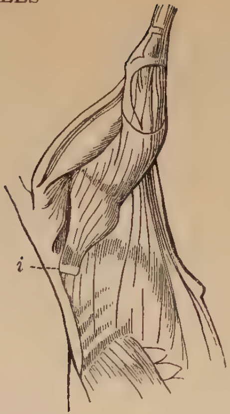
Delmonico steak

(Adapted from Maria Parloa's "Home Economics," by permission of The Century Co.)

BONES—MUSCLES

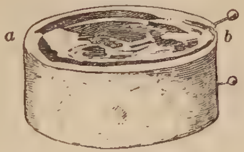


Shows changed position of thigh-bone when the hind quarter of the animal is hung; *i*, the point where loin is separated from hip sirloin



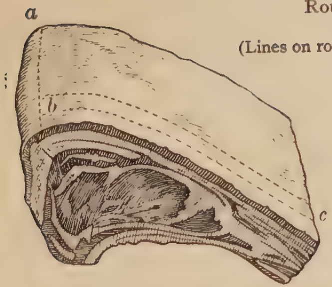
Shows changed position of muscles when hind quarter is hung; *i* is the point where the loin is separated from the hip sirloin

CARVING ROASTS

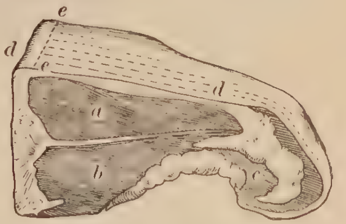


Round of beef

(Lines on roasts indicate carving)



Roast ribs of beef



Sirloin or porterhouse roast

COMPOSITION OF MEAT

Meats contain, in common with vegetables, protein, fat, mineral matter, and water. They lack carbohydrates, the chief constituent of starchy vegetables. Meats contain more fat and protein than vegetables. It is for its *protein* and *fat* that meat has nutritive significance in human diet.

In vegetables, carbohydrates were found to include starch, sugar, cellulose. The action of any vegetable in the human system depends upon which of these forms of carbohydrates is present, or present in largest quantity.

Protein also is complex. *Albumen*, *gelatin*, *nitrogenous extractives*, are present in protein. Though these are all nitrogenous, they are differently composed and serve the body differently. Albumen builds tissue; gelatin spares tissue, but does not build it; extractives do neither — they stimulate. They have little, if any, nutritive value. By stimulating, however, they cause a secretion of digestive juices, which promotes digestion, hence nutrition, when the stimulation is not excessive. The flavor of meat due to extractives increases palatability. *Extracts* of meat contain mainly extractives.

Albumen is coagulated when meat is cooked. In boiling it rises on the water as brown particles. These are highly nutritious, therefore should not be skimmed off. The solidifying of the liquid in which meat has been boiled is due to the gelatin. When this is present in the diet it is used by the body and thus protects body-tissues. The body would consume itself in living if deprived of all protein food. Gelatin is a sparer of tissue instead of a builder. It is called a tissue-sparer. Veal is especially rich in gelatin.

When would you choose mutton in preference to beef? Why? When not? Why? In what respects does pork differ from beef and mutton? Compare young and old animals; young and old vegetables.

The composition of meats is in general the same. The location of different parts largely determines not only the tenderness but also the quantity of bone. Hence the imperative need to know in buying meat the character of different cuts and the tests of the quality of meat. Though cuts differ somewhat in different animals, there is a general likeness in the form and structure of animals, therefore in the way they are cut. The cuts of beef are more complex, therefore include or suggest those of other animals. (See pp. 90–93.)

The amount of bone, also of fat, affects the actual quantity of nutriment of any piece of meat, as it is lean meat that furnishes the protein for which meat is primarily valued as food. The bones and trimmings of meat are not, however, without food value. Bones are valuable for soup-stock. If bones and fat are paid for with meat, they should be obtained and used. When meat is trimmed, then weighed and the trimmings utilized in processes of wholesale manufacture, a general economy is practiced which should be encouraged in all communities.

Cuts of meat which contain much bone and fat should be less expensive. The range of price of meat is large, also exceedingly varying. In general, 3–5¢ per pound is an average range for soup-meat, 25–40¢ for steak, and sometimes $1 or more a pound for the tenderloin when purchased alone. Though only approximate prices can be quoted (because so subject to unstaple trade conditions), the relative difference between prices varies less, because this depends upon the difference in the meat itself, which is practically a permanent difference.

Texture of meat should be firm, but not long fibers, stringy, or dry. *Fat* should be apparent but not excessive, firm, and creamy white. *Bones* should not be exceedingly large. *Color* should be red, bright almost immediately upon cutting, though inclined to bluish red as cut.

As raw meat is found to be more digestible than cooked, the cooking of meat is clearly for other purposes. This also suggests that the rarer cooked meat is, probably the more digestible. For tender meats experiment confirms this expectation. Cooked meat is, however, generally more palatable than uncooked. As 95% of it is digested when cooked, cooking is considered advisable. Cooking develops flavor; it also destroys bacteria and any other parasites present. Overcooking is to be avoided, as this hardens fiber, making it indigestible.

In vegetables, cellulose was found so to incase the nutrients as to need to be broken up in order to release these. In meats, connective tissue holds together the muscle fibers; in it are embedded the fat particles. As cellulose was loosened and softened by heat, so connective tissue by means of heat loosens its hold upon the muscle fibers and the fat. The connective tissue itself becomes gelatin. (See pp. 94 and 98.)

In young animals connective tissue is delicate and the muscle fibers short and tender. With age, exercise, exposure, both muscle fiber and connective tissue toughen and harden. They then require more prolonged cooking. When tender, heat acts quickly upon them.

Tender meat is subjected to high temperature for a short time.
Tough meat requires low temperature and prolonged cooking. Why?

To retain nutrients in meat, dry heat is used. Large, thick cuts of meat are seared (juices and fat brown together quickly on outside). When the inside is thus incased it really cooks in the water of its own composition, rather than by dry heat as did the outside. The albumen that has coagulated on the outside prevents the further escape of the meat-juices. It is such cooking that makes meat most nutritious, unless it is very tough. Steaks are so cooked.

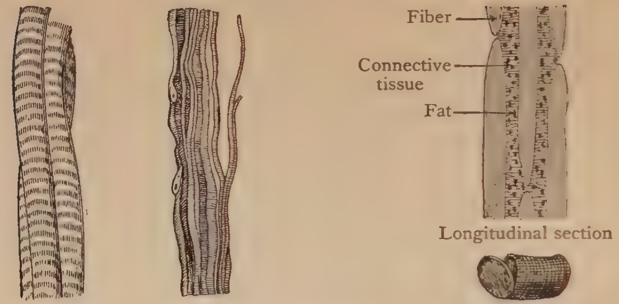
All meats as cooked lose some weight. This loss is, however, principally water. This is caused by the hardening of fiber forcing out the water. (Fresh meat does not shrink as much as unsound, for meat as it undergoes decomposition grows liquid.) By boiling, about $\frac{1}{2}$ the weight is lost. Of this less than 5% is of nutrients. By dry heat about $\frac{1}{3}$ is lost as water, while the loss in protein is very slight. Yet more of the nutrients actually become soluble by dry heat than during boiling. But these are not lost if gravies and sauces are made with the juices and drippings. Cooked meat is as a whole somewhat less soluble than uncooked. In so far as it is, it is decreased in nutriment, for food, to be used by the body, must be soluble in its digestive juices.

Meat-juices obtained by pressing heated round steak are nearly 12% protein and extractives. The extractives are one half as much as the protein. But since no method of cooking brings out the nutrients to any great degree, they are mostly in the meat, even stew- and soup-meat. This should therefore be considered a food of value, though it needs to be so prepared as to increase its palatability. Meat-powder is for this reason more nutritious than meat extracts.

To extract nutrients meat is cut fine, soaked in cold water, and cooked at low temperature. Near the end of this process the temperature is raised to the boiling point for a short time to dissolve the connective tissue. *High temperature hardens muscle fibers but is needed to dissolve connective tissue.* Stews and soups are so made. (In retaining nutrients after searing, the temperature is lowered to prevent hardening of the fibers.) (See p. 98.)

Building, sparing, stimulating effects are produced by meat foods.

MUSCLE FIBERS IN MEAT



In bundles In fibrils Longitudinal section Transverse section

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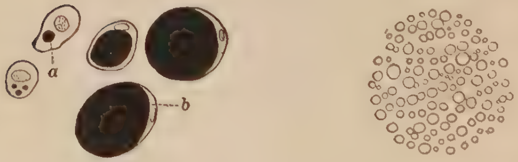
Compare Structure of Muscle Fibers with Plant Structure, p. 75.
See arrangement of muscles in animals, pp. 90 and 93.
Cut meat lengthwise and crosswise.
Decide which is tougher as eaten.
Note location of fat in fiber above.
Note Fat-Globules in Milk, p. 114.

FAT-GLOBULES



Fat cells

a, young cells beginning to store fat
b, old cell filled with fat

Fat emulsified

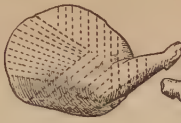
Fat is broken up thus into finely divided particles as it is digested

(After Conn and Buddington)

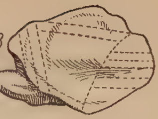
SHOULDER OF MUTTON

Position of shoulder-bone

Muscles of shoulder

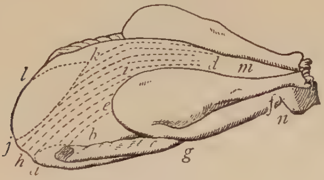


Method of carving



Method of carving the under part

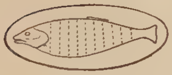
CARVING FOWL



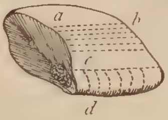
Remove wing *a–b*
Remove leg *c–d*
Disjoint thigh at *e*
Remove side-bone *f–g*
Slice breast *h–i*
Remove wish-bone *k–j l*
Remove collar-bone under wing
Open at *m*
Disjoint at *n*

(*Letters on carving cuts throughout book indicate cutting in the order of the letters*)

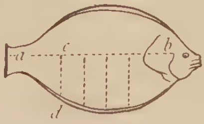
CARVING FISH



For small fish



For fish steaks



For large fish

(Adapted from Maria Parloa's "Home Economics," by permission of The Century Co.)

The large animals from which most marketed meats come belong to the animal family of mammals, whose young are milk-fed. The cow's milk has become an important human food. Besides these animals others are used for food, which are smaller: some domesticated, others wild; some of land, others of air. The egg from which some of these spring also becomes human food. It contains what forms the animal and furnishes its food until it is capable of living on food supplied by nature, though provided through the care of the parent.

Chicken is the most generally used of these smaller animals. It furnishes protein food that is delicate and digestible. It is relatively free from fat. As chickens grow old they grow fat and tough, necks long and flesh purplish. The characteristics desirable in chickens used for food are:

Breast plump with *breast-bone* pliable (not broken): *flesh* evenly compact (neither hard nor flabby); *skin* moist, smooth, clear (yellow or white); pin feathers show youth; hairs, age; *legs* short, thick; *feet* yellow, soft.

Broilers are young and tender. Fowl requires boiling to be palatable.

Capons are larger than chickens, of finer flavor, and tender in texture.

Turkey is similar to chicken but with more fat. Fat is even further increased in ducks and geese. Pigeons when wild and old are tough and the flesh very dry. Squab (tame, young pigeon) is very palatable. Quail and partridge are similar as foods. Rabbits and venison are also wild, dark, edible meats.

The flesh of all such animals is dry, with less red blood, but with valuable salts and usually less fat. The flavor is distinctive. The dark meat is richest in nutrients; the white requires thorough cooking. The breast is the tenderest part. "Legs of walkers" and "wings of fliers" are the most exercised, so toughest. Storage of such meats for long, changes muscle fibers and connective tissue; also solubility of nutrients.

Fish is similar to white meats such as veal and chicken, but has a high percentage of refuse ($\frac{1}{3}$–$\frac{2}{3}$) and is from $\frac{1}{3}$–$\frac{1}{2}$ water. This leaves little solid in any given weight, but as fish is relatively low in cost, it is not expensive protein (building) food. It is as a digestible protein food that it is valued. Salts of fish do not vary significantly from those of meats, as is often claimed.

The composition of fish differs rather widely. Though this is most noticed in the fat, it is marked in the amount of protein. Protein in fish is partly gelatin. Fish with less than 2% of fat (cod, haddock, whitefish) are most digestible. Those with more fat, but less than 5% (mackerel, halibut), are palatable, as are also those with even more than 5% (salmon, herring, bluefish), though these are much less digestible. The flavor of fish is affected by their food and the conditions under which they live. In salting and preserving, fish, like all meats, lose water, so have higher per cent of nutrients in this form.

Only when fresh can fish be eaten with even safety; only near the source of the supply is fish food advisable. No food decomposes more quickly or dangerously. Toxic substances (ptomaines), resulting from decay changes, are produced in stale fish; these act as poisons in the human system. Fish should always be kept on ice and invariably used promptly. When fish has been frozen it should be thawed in cold water and cooked at once. It keeps even less well than when fresh.

Thorough cooking of all fish is imperative; the danger from parasites is thus averted. Such sea fish as sea-shad require cooking by a method that permits escape of oil. After cooking, all fish should be opaque, not clear. This does not require exceedingly high temperature. Boiling is, however, less desirable than dry heat of temperature even a little below the boiling point of water, but sufficiently continued.

Oysters are the shell-fish most generally used, due to their palatability, digestibility, and high percentage of nutrients. China and Italy cultivated oysters 2000 years ago. There was a British oyster industry in 50 B.C.

It is heard that oysters are very similar in nutrients to milk. In quantity they are $\left(\begin{array}{llll}\text{Milk has water,} & 87.1\%; & \text{nutrients,} & 13\% \\ \text{Oysters,} & \text{"}\ 88.3\%; & \text{"} & 12\% \end{array}\right)$; also in containing some of all food-constituents, even carbohydrates, so rare in animal food. (Its form in oysters is glycogen, the sugar in the liver.) But the proportion of the different food-constituents is widely different. (See p. 103.) Protein in oysters is nearly double that of milk. Compare other constituents.

Though oysters are more digestible raw, they are not wholly safe thus. When fattened in shallow water or kept in water, as they usually are while in market, they readily absorb any disease-germs the water may contain. These they then transmit. Such "floating" of oysters gives them a plumper appearance, but the smaller-appearing oysters may be safer. Oysters slightly cooked are digestible and safer. Overcooked oysters are toughened to indigestibility.

Shell-fish in general (clams, oysters, scallops, shrimps, lobsters) are not easily digested by all persons. Clams have a tough muscle; crabs and lobster, firm, compact fiber that requires thorough mastication. Shell-fish must always be fresh and from a near source of known security from disease.

In general, all-year fish have little fat, as also those available in winter; spring fish have more; summer, most. Range of cost varies similarly, though among those with fat, bluefish, mackerel, herring, eels, are cheap. Dried and smoked fish are nutritious, inexpensive, and safe. Canned fish must be taken from can when opened and used promptly. All these fish-foods build tissue and do not stimulate as do meats with extractives.

Fish are available as follows:

All year — Bass (3–8 lb.), clams, cod (3–20 lb.), eels ($\frac{1}{2}$–1 lb.), flounder ($\frac{1}{2}$–4 lb.), haddock (5–8 lb.), halibut, lobster (1–2 lb.), pickerel (1–4 lb.), sardines, salt and smoked fish. (Range in cost, 6–25¢ per lb.)

Winter — Oysters (September–May), smelts (September–March), whitefish. (Range in cost, 10–25¢.) Oysters higher.

Spring — Herring, shad, trout. (Cost, 25¢–$1.) Herring cheaper.

Summer — Bluefish (June–October), crabs, mackerel (April–October), perch, salmon (May–September), swordfish (June–September). Range in cost, 5–50¢. Bluefish least expensive.

If expense needs to be carefully guarded, what effect would this have in the choice? Which fish could be depended upon at each season? Which would need to be supplemented by fatty or other heat-giving foods.

FISH AND EQUIVALENT FOODS COMPARE THESE

REFUSE	WATER	% IN	PROTEIN	FAT	CARBOHYDRATES	ASH
29.9	58.5	Cod (fresh)	11.1	.2	—	.8
24.9	40.2	Cod (salt)	16.	.4	—	18.5
17.7	61.9	Halibut	15.3	4.4	—	.9
44.4	19.2	Herring (smoked)	20.5	8.8	—	7.4
44.7	40.4	Mackerel	10.2	4.2	—	.7
35.1	50.7	Perch	12.8	.7	—	.9
50.1	35.2	Shad	9.4	—	—	—
—	71.2	Shad roe (eggs)	20.9	3.8	2.6	1.5
—	63.5	Salmon (canned)	21.8	12.1	—	2.6
5.	53.6	Sardines	23.7	12.1	—	5.3
—	80.8	Clams	10.6	1.1	5.2	2.3
52.4	36.7	Crabs	7.9	.9	.6	1.5
—	88.3	Oysters	6.	1.3	3.3	1.1
61.7	30.7	Lobsters	5.9	.7	.2	.8
—	87.1	Milk	3.3	4.	5.	.7
11.2	65.5	Eggs	13.1	9.3	—	.9
41.6	43.7	Chicken (young)	12.8	1.4	—	.7
25.9	47.1	Chicken (old)	13.7	12.3	—	.7
24.5	54.2	Veal (fore)	15.1	6.	—	.7
20.7	56.2	Veal (hind)	16.2	6.6	—	.8

(Rearranged from *Farmers' Bulletin No. 142*, United States Department of Agriculture)

EGG-CHARACTERISTICS

Eggs raw are usually digested in the intestines. This makes them of use when the stomach itself is not in condition for use, but may cause diarrhea. Eggs serve as a concentrated protein food.

The sulphur in eggs, which blackens the spoon, forms, in union with other salts and fat, a compound fat (lecithin) in the egg-yolk, not always easily digested by every one. When it is not, the egg-white can, and should still, be eaten alone. But as egg-yolk contains not only more fat and protein than egg-white, it promotes growth and is to be eaten when possible. It digests raw or hard-boiled, if mixed with vinegar.

Eggs when *fresh sink* in cold water. As eggs decompose, the gas formed makes them lighter and the egg is thinner in constituency. When *fresh*, eggs look *clear* through the *center*, if they are held before a candle-flame in a dark room. Fresh eggs do not rattle when shaken. Their shells are full. Evaporation with standing empties them somewhat.

In brine (salt 2 oz. — water 1 pt.) eggs *1 day old sink*; eggs *3 days old float beneath surface*; those *14 days old, on the surface*.

For Egg-Refrigeration see p. 220.

[*Egg, milk, seeds (grains), are foods for young animals and plants*
Food for young animals or plants stores for them their tissue- and heat-supply]

YOUNG CHICKENS

"These chickens are but a few days old. Older chickens have relatively larger bodies and longer necks and legs"

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Because the shell of the egg is porous, the water of the egg evaporates as it stands exposed to the air. The egg becomes lighter; not only air but bacteria can and do enter the egg; decomposition results; gases are formed; the egg grows lighter still. The readiness with which eggs decompose makes it important to move them with such care as not to break the tissue that separates the white and yolk. Eggs need also to be kept free from contamination in handling, keeping, using. That they may remain fresh, air must be excluded. (See p. 108.)

Freshness of eggs can be preserved by covering the shell with paraffin or oil or embedding them (*with small end down*) in bran, sawdust, or salt, and keeping them where it is dark and cool. Experiment stations and agricultural colleges furnish information about coatings for eggs, also sometimes what is popularly called "water-glass" for protecting eggs from air. Though this makes possible the purchase of eggs when fresh and cheap for later use, any overkeeping of eggs is to be avoided. Cooking-eggs need freshness no less than those eaten alone, to which palatability is indispensable.

Stored eggs deteriorate. Dried eggs keep better. "Broken" eggs are liquid and shell-less, with some preservative (borax or formaldehyde) that conceals putrefactive odors of *unsafe and unsalable* eggs. "Broken" eggs form a commercial product from a locality where eggs are plentiful, but too distant to be transported in their natural state. Such eggs should never be used and are not, except as food-ingredients in commercially manufactured foods, as cakes. Egg-substitutes, such as gelatin egg-colored, though not to be commended, are less dangerous, if good gelatin is used. "Broken" eggs are disease-breeding. It should be known, where home preparation of food is not practiced, that they are not being used in any foods eaten.

Natural quality of eggs, like that of all food, depends upon the food and condition of living under which they are produced. The flavor, color, and keeping quality of eggs vary. Though color is not reliably indicative of composition, dark-shell eggs usually have larger yolks, so are richer in fat. White-shell eggs are usually more delicate in flavor and sometimes for this reason more acceptable to invalids. The flavor of all eggs is better in the spring; it is at all times dependent upon the food of the fowls. As with milk, so with eggs, the taste and odor of the food the animal consumes passes to its product. Hens fed little nitrogen have been found to produce many eggs but with a maximum of water, and keep poorly. Abundant food of both nitrogen and non-nitrogen compounds results in larger eggs that keep better.

Production of eggs coöperatively has in some communities insured a supply of freshly laid eggs. It is claimed that 40 hens in an outlaying lot 40′ × 40′ cared for scientifically by boys have supplied a city neighborhood and provided support for a family. Whatever the source of the egg-supply it needs to be reliable and to furnish good eggs at all seasons. The quality of eggs is no less important than that of meat or milk. Less tender cuts of superior animals may be cooked palatably; unfresh eggs cannot be. Skim-milk from healthful cows is wholesome, though less rich than whole milk. Inferior eggs are unpalatable and easily become disease-breeding instead of health-giving.

All food should be purchased by weight, even eggs. They range in weight per dozen from 1 + lb. to $1\frac{2}{3}$ + lb. (or $1\frac{1}{2}$ oz. to $2\frac{1}{3}$ oz. per egg). One pound of steak without bone serves 3 persons. How many eggs would equal the amount eaten by each? How many eggs would equal in protein the protein in $\frac{1}{3}$ lb. beef? Compare this number with that which equals it in weight? Would so many eggs be eaten by any one at a time?

Of foods with little waste and large percentage of nutrients, eggs, milk, bread, are the most important. Though they are often called whole, entire, complete, or perfect foods, they are rather *concentrated foods*, universally used wherever their expense does not forbid. Only milk ever serves alone for human food, and it does so only in infancy for a limited period. But eggs, milk, bread, are concentrated foods of great value.

Eggs supply the materials from which chickens form. Until their activity begins, their need is for water, 74%; nitrogen, 12%; fat, 10%; mineral salts, 1%. Part of the shell may be used as needed. The shell is porous; the air enters through it, which is used in the changes occurring as the chick forms in the egg. With the beginning of active life chickens need, and take so soon as they emerge from the shell, the meal-food that gives them energy. Like meats, eggs have no carbohydrate, but some fat, though not enough to sustain human activity with egg-foods.

% IN	PROTEIN	FAT	MINERAL SALTS	WATER
Egg whole (without shell)	$\frac{1}{8}$ +	—	$\frac{1}{100}$	$\frac{3}{4}$
Egg-white	$\frac{1}{8}$	$\frac{1}{8}$ —	$\frac{1}{100}$	$\frac{9}{10}$ —
Egg-yolk	$\frac{1}{6}$	$\frac{1}{3}$–$\frac{1}{2}$	$\frac{1}{100}$	$\frac{1}{3}$–$\frac{1}{2}$
Egg-solids	$\frac{1}{2}$ +	$\frac{1}{3}$	$\frac{1}{8}$ (shell)	—

Milk has carbohydrate that egg lacks, and meat has extractives. Meat contains the products of decomposition due to activity of animals; eggs do not. Egg-white contains about the amount of water in milk. Egg-solids are chiefly protein in the form of albumen; this is most digestible, especially raw. Egg-yolk contains more fat than is found in cream. (See p. 114.) Egg-salts, in both white and yolk, like those of milk, are of value, particularly for growing children.

As eggs are laid the shell is almost full of material. The egg-contents do not thicken for nearly twelve hours. It is better even to delay their use for twenty-four hours longer. Only eggs that are newly laid or kept fresh are fit for human food.

Eggs are used not only as an article of diet, that is, a food at a meal, but also largely as a food-ingredient, as in flour- and other food-mixtures. They add nourishment and lightness. Compare composition of eggs, chicken, veal, fish, milk (p. 103). By what should eggs be supplemented? Choose specific foods from table on p. 192. What foods can eggs be substituted for?

Cooking of eggs is important, as it affects their digestibility. Eggs, like meat, lose water when cooked; otherwise they do not change in composition, but the albumen coagulates. The protein and fat of egg are usually entirely assimilated. Egg-yolk cooked either soft or hard is equally digestible with uncooked. Egg-white uncooked is more digestible than cooked.

DIGESTIBILITY OF COOKED EGGS

Eggs	cooked	at	212° F.	for	3 min.,	after	5 hr.,	8+% undigested
Eggs	"	"	212° F.	"	5 min.,	"	5 hr.,	4−% undigested
Eggs	"	"	212° F.	"	20 min.,	"	5 hr.,	4+% undigested
Eggs	"	"	180° F.	"	5–10 min.,	"	5 hr.,	fully digested

(Results in a government food-experiment) Note time — temperature — result

Hard-boiled eggs require thorough mastication.

For adults in health eggs are a wholesome repair food. Though the yolk gives seven times the heat-energy of the white, eggs need to be combined with energy foods. If eaten with bread or on toast, what they lack is added. For children and invalids they give, besides salts, a most digestible protein that builds advantageously for growth and recuperative repair.

Foods that contain in appreciable quantities all the constituents that sustain life are substantial factors in the diet, though none are so balanced in their constituents as to be a desirable diet alone. Milk is more nearly so for children than other substantial foods are for any one. But even milk when used alone in infancy requires some modification.

The purity of the milk-supply is one of the most important of the food-problems of humanity. Every community is in need of pure milk in abundance. The health and growth of children is largely dependent upon this. Neglect of the milk-supply is negligence toward life itself. Children need care taken for them of the milk they are to drink; they are helpless themselves. (See Milk Commissions, p. 115.)

Cleanliness of the environment of milk-cows, of cows themselves, of workers, and of receptacles is an absolute requirement for a clean milk-supply. The health of the animals, their food, the water they drink, the air they breathe, all affect the quality of milk they give. Mixed milk from a number of cows is preferable to milk from one, as such a supply minimizes the probability of poor milk, also of concentration of any unsuspected danger. Milk-cows need constant intelligent inspection and care.

Transportation of milk is to-day almost universal. In such dissemination milk needs protection from dust and contamination, and must be at lowered temperature to prevent not only souring but the development of any bacteria. The delivery of milk, through which it is widely distributed to family consumers, requires no less scientific attention, though it usually receives less. Consumers, too, have a responsibility beyond caring for the milk they use, in the complete cleaning of milk-bottles immediately upon emptying them.

In infancy, milk is the food of the child until its ninth month. During its first year a child takes approximately 125 gallons (1000 lb.) of milk. A child takes $\frac{1}{7}$ its weight in food daily. In a year it has gained 13 lb. Of the 1000 lb. of milk 130 lb. are milk-solids (40 *P* — 40 *F* — 50 sugar), which build the child-body 13 lb., supply its heat and energy for its activity. For every pound of food that has gone into building the body, 9 lb. have been used in living the life.

With childhood's second year the food-need changes to one of growing variety in food. Milk continues as part of its diet, but a decreasing part, until in adult life milk becomes principally a food-ingredient. If in adult life milk is used as a beverage, it must be regarded as a substantial factor in the diet. The foods with which it is combined must supplement, not duplicate milk in composition, or the body will be overburdened with unneeded food. In illness, when activity is lessened, milk then often fully meets the body-need for sustenance and reënforcement of physical resistance. Milk is deficient in energy-giving power. It is a building and tissue-repair food in liquid form.

In made foods milk as an ingredient increases the nutritive value and palatability. Used as a cooking-liquid in substitution for water, it increases richness and fineness of texture.

In composition milk is nearly $\frac{9}{10}$ water (87.1%). It contains 4% protein, 4% fat, 5% sugar, 1% mineral matter. In adult-diet even a light diet or narrow ration (that is, a diet in which there is little carbohydrate in proportion to protein) contains $2\frac{1}{2}$ times as much carbohydrate as protein. In milk the sugar (carbohydrate) is only $\frac{1}{4}$ more. Were adults to attempt to live on milk they would take an excess of water (children need more proportionally) and more protein and fat than the body can stand, in order to get the carbohydrate it needs.

The composition of a food shows the quantities of its constituents. Thus is disclosed the *possible* nutritive value of food. How these constituents act in the human digestive tract controls their use to the human body; this is their digestibility. Food must be or become soluble and ultimately somewhat liquefied for passage through the digestive tract and into use by body-tissues. Though milk is in liquid form and composed of soluble substances, it undergoes a number of changes before it comes into actual use to the body. How the body is able to effect these changes determines the digestion of a food. Though the general process of digestion is alike in all persons, all have not the same degree of vitality in all parts of the digestive tract, therefore cannot digest equally well all foods. Milk is one of the most digestible of foods (95% is digested), yet some persons do not digest it easily or quickly. (See p. 218.)

Different digestive agencies make the different food-constituents of use to the body. Therefore what happens naturally or otherwise to change food-constituents must be observed, if food is to be made digestible. (See p. 113.)

Milk-solids (13% in all) are its nutrients. These are held in solution in the 87% of water in milk. But in the stomach, milk becomes a solid food that must be broken up again. In this usually lies the digestive difficulty whenever it exists. Protein in milk is in two forms, casein and lact-albumin. The latter is only $\frac{1}{7}$ of the protein; it coagulates with prolonged heating.

Casein (3% of milk-solids) becomes a solid when milk sours, or acid or rennet is added, or it is heated. This is called the curd. The liquid left is the whey; it holds the sugar and mineral matter. When rennet is added to milk, casein coagulates and changes; this happens in the stomach.

Milk taken slowly into the stomach usually forms curd in small particles, so is digested thoroughly. Crackers and crumbed bread in milk also prevent the formation of a large clot and thus make milk more digestible. When milk is used as a food-ingredient, this is also effected. The lime salts in milk keep the casein in solution. Lime-water added to milk acts similarly in preventing an indigestible clot's forming in the stomach. Barley-water in milk also does this.

Protein in milk forms the scum when milk is heated. It is the change in the protein in milk that makes boiled milk less digestible (when it is so) than uncooked milk. Hutchinson, the food-scientist, claims that milk heated even to the boiling point for 30 min. is as fully digested by infants as raw milk. Many others say it is less so. But to insure its safety when its source is not securely sanitary, it is heated to destroy all germs possible. (See pasteurized and certified milk, p. 118.)

Fat in milk (cream) is broken up into fine globules. This facilitates its digestion. (Fat particles are visible under the microscope; see them if possible.) Cream and butter are both digestible, indeed the most generally digestible fats. Fat is the constituent that varies most in milk. Four per cent is the average; it ranges from 2 to 6%. This is sometimes a natural difference due mainly to the difference in feeding cows and the breed. Adulteration may also alter the quantity of cream.

Carbohydrate in milk is in the form of milk-sugar (lactose). This sugar is less sweet and less fermentable than other sugars; it is therefore in less danger of disturbing digestion.

Salts of milk (chiefly potash, lime, phosphates) aid in holding the solids in solution. In the body these salts build bone, besides furthering digestion. In illness involving bone-deterioration these salts act as repair agents.

Whole milk is milk as it is produced. As milk stands, the cream forms by the fat rising to the top. When the cream is skimmed off, the milk left is known as skim-milk. Besides these three natural forms of sweet milk the constituents of milk are separated differently and serve different but common food-purposes. The fat to form butter is taken from cream that contains from 9 to 46% fat. Butter is a concentration of milk-fat. It contains an average of 86% fat. The government requires that it have at least 82.5% and not more than 16% water. The curd of milk is separated, giving a similar concentration of protein that with some fat forms cheese.

MILK AND ITS PRODUCTS

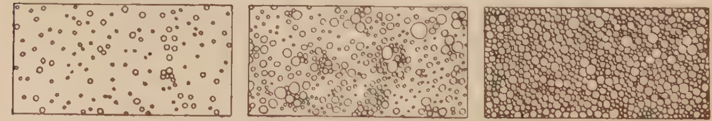
% IN	PROTEIN	FAT	SUGAR	ASH	WATER
Whole milk	3.3	4.	5.	.7	87.
Skim-milk	3.4	.3	5.1	.7	90.5
Buttermilk	3.	.5	4.8	.7	91.
Condensed milk	8.8	8.3	54.1	1.9	26.9
Cream (see note below)	2.5	18.5	4.5	.5	74.
Butter	1.1	85.	—	3.	11.
Cheese (Cheddar)	27.7	36.8	4.1	4.	27.4
Cheese (full cream)	25.9	33.7	2.4	3.8	34.2

(From *Farmers' Bulletin No. 142*, United States Department of Agriculture)

Milk weighs about 1 lb. per pt.; 4½ lb. yield 18.5% fat in cream (1 lb.). How much fat will be in 1 qt. milk? ½ pt. cream? Compare ratio of fat in each with ratio in cost. What proportion of cost is left for expense of separating and separate delivery?

Cream removed by a separator is 38–46% fat, 6+% solids, 51+% water.

FAT IN MILK (GLOBULES MAGNIFIED 300 DIAMETERS)



Skim-milk *Whole milk* *Cream*

The heat-energy supply from milk comes mainly from its fat. Milk brings only sugar as a carbohydrate. The body needs starch as well as sugar. Bread, crackers, corn meal, rice, added to milk, increase the carbohydrate and bring starch into the diet.

Milk alone digests from 95 to 97% when taken slowly. In a mixed diet (animal and vegetable food) it digests completely. It furthers the digestion of other foods with which it is prepared or eaten, when it is incorporated in the diet, not added beyond the need for food. Milk taken quickly is acted upon as a whole by the rennin. The casein is formed into a large clot that the digestive juices cannot penetrate quickly or fully.

Cream that is stiff rather than simply thick is probably adulterated with gelatin. If in 12–18 hours cream of good quality does not rise to about $\frac{1}{14}$ of the volume of the milk, that milk is not of superior quality. Skim-milk is $\frac{1}{3}$–1% fat; whole milk, 2–6%; cream, 15–35%. Cream should be $\frac{1}{4}$ fat as purchased. Butter has about 4 times as much fat as cream (only twice that of "separator cream"). As fat is laxative in effect, it furthers digestion of milk. Skim-milk is therefore less digestible, except as a food-ingredient in cooking; it is nutritious and inexpensive.

Compare cost of butter with that of cream. What percentage is left for work in butter-making? Compare whole and condensed milk, whole and skim-milk. (Note especially nutritive value of skim-milk.) Use skim-milk and buttermilk. The flavor of the latter is the greatest appreciable difference. This is agreeable to many. For adults it is usually digestible. It may aid digestion through the agency of bacteria present.

All communities need and are increasingly establishing *Milk Commissions* to insure scientific inspection and regulation of all milk marketed.

See a dairy and creamery in operation if possible.

Experience shows that milk undergoes many changes. Science has studied these and finds they are effected by the presence of bacteria. Though milk has been experimentally obtained without any bacteria, it is not without bacteria as it comes into use. Bacteria usually multiply rapidly. Though all are not harmful, any bacteria consumed in large numbers undermine health and gravely affect the death-rate of infants.

Drs. Park and Holt find, of infants under 1 year, during 3 mos. in summer:
None died that were fed *human* milk or *certified* milk of cows:
3% died of those fed *pasteurized* milk (treated to reduce bacteria);
9% " " " " *bottled* milk (protected thus from dairy);
20% " " " " *condensed* milk or *loose* milk sold open in bulk.

Milk feeds germs. Many that would not grow in water thrive in milk. Some produce harmless changes in milk as souring. Others change the milk itself dangerously; this happens when milk is kept under unsanitary conditions. A ferment may then enter it which produces a substance (tyrotoxicon) that causes serious, even fatal, intestinal disorders. It is this that happens when ptomaine poisoning occurs from cream, ice-cream, cheese. A third type of bacteria are themselves directly disease-producing and may grow in milk without changing its composition significantly. But when these enter the human body with the milk, they there cause detrimental changes in body-tissues. All bacteria cannot live thus, but those producing many human diseases can, such as those of dysentery, cholera, typhoid and scarlet fevers, diphtheria, tuberculosis.

Disease-producing Bacteria

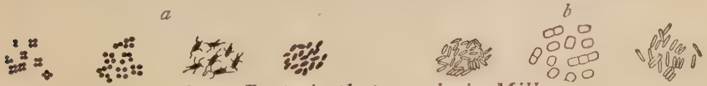
a, pus-producing; *b*, pneumonia; *c*, tuberculosis; *d*, tetanus (lockjaw). (Conn and Buddington) *e* and *f*, typhoid bacilli. (Pfeiffer) *g*, pus; *h*, dysentery. (Sleiger)

Souring of milk is produced by lactic-acid bacteria. During it some of the sugar of milk (lactose) is converted into lactic acid. (What is the effect of acid upon milk?) Bacteria in living take what they need for food by breaking up the substances used. The products resulting from this, their life-activity, finally make their own growth impossible, though not essentially the growth of other bacteria. Lactic-acid bacteria ultimately cease to grow as milk sours. Souring then goes no further; the sugar that is then unchanged remains as sugar.

Milk sours easily; that is, lactic-acid fermentation occurs readily when milk is open to the air at or above the usual house-temperature (70° F.). Milk that does not sour under such conditions within a few hours has generally had some chemical added to counteract the acidity or prevent the fermentation.

Temperature below 70° F. checks souring, as it is unfavorable to bacterial growth. Milk should be kept on ice or in a cooled atmosphere; it should be cooled immediately after a milking, to avoid souring. Sudden change of temperature will often sour milk that has stood, as will mixing milk of different ages. Sour milk is of value in cooking; is advised as a drink by some diet-specialists, but only as the kinds of bacteria that it will contain are scientifically controlled.

In the house, as in the dairy, milk must be kept in clean utensils, covered but not air-tight (as some bacteria grow in it only in the absence of air), and at low temperature in an atmosphere free from odors, as milk readily absorbs these. It should be kept in an isolated compartment in a refrigerator.



Some Bacteria that may be in Milk

a, lactic acid, produce souring; *b*, produce slimy milk. (Conn and Marshall)

Milk needs to be both fresh and clean. Its purity and freshness may both be destroyed by bacteria. Hence bacteria must be excluded so far as possible, and milk must be kept under conditions that discourage bacterial growth, so that disease and death to infants may not ensue. If milk-bottles are not effectively sterilized before they are re-used, they can breed disease and spread it by contaminating the atmosphere as well as by carrying into milk whatever they contain. To heat milk sufficiently (180° F.) to destroy the bacteria that may be harmful changes its protein, as noted earlier. Since it has not been conclusively proved that it is assuredly as digestible for children thus, other means of making it safe have been sought.

Certified milk is milk that has had every care of environment, animals, workers, receptacles in its production. Animals, workers, and milk are all scientifically examined. The milk is then bottled in sterile bottles with sterile covers. Even milk so cared for is not germ-free, but it has only a few thousand bacteria where other milk has millions. Only with the rarest exceptions has certified milk been found to contain disease-producing bacteria. It costs nearly twice what is charged for ordinary milk.

Pasteurized milk has been evenly heated for *10–20 min. at 157° F.*, at which temperature the bacterial life is greatly reduced and milk is changed less than when boiled. This is accomplished by heating milk in bottles in a water-bath at 159° F., so as to avoid high direct heat. Formerly pasteurizing was advocated as a home precaution, then scientifically somewhat discouraged for a while, but is now re-advised as a more general practice for the milk-supply. Such milk is not so palatable, but is safer. Yet bacterial spores (see p. 71) are not destroyed, so its safety is not completely assured.

Milk germ-free is the need, but to be made sterile (germ-free) would require a degree of heat which changes its composition and digestibility unfavorably. Pasteurized milk and certified milk, as noted, are safer than ordinary raw milk. Other means to this end change the form of milk somewhat.

Milk-powder is mainly milk-curd dried and powdered ; it is mixed with water as used. Evaporated milk is skim-milk with the water evaporated ; it contains the solids of skim-milk. Its principal use is that of being mixed with special prepared flours. Condensed milk has had most of the water evaporated, high heat applied to destroy bacteria, and sugar added. Sugar acts as a preservative, but it renders such milk unfit for use for all purposes milk usually serves. All these forms of preserved milk may become re-infected with bacteria after they are opened for use. Koumiss is fermented milk that is of such digestibility as to be a valuable adult invalid food.

Color of milk is not essentially indicative of quality. Light-colored milk may be superior to rich-looking milk, as the latter may be artificially colored ; but very pale, thin milk, even if not watered, is poor. Sediment in milk indicates adulteration or lack of cleanliness.

Milk that shows neglect or adulteration should be referred to the Board of Health or Milk Inspector or Commission.

Butter as well as milk and cream needs to be fresh and pure. Pure butter boils quietly when heated in a spoon ; impure does not.

Milk furnishes principally protein and fat. The sugar and mineral salts are far from unimportant, but would not in themselves give milk the significance it has as a food. The separated fat gives cream and butter ; the separated protein with some fat and salts gives cheese.

Butter, like cream, from which it is separated by churning, is the most digestible animal fat. Fat gives over twice the heat-energy of the same amount of starch or sugar and gives it more rapidly than starch. But only one fourth or less of the energy food of the body can come from fat. Butter is the staple diet-fat, except where it cannot be afforded.

Some substitutes for butter are wholesome, and if sold for what they are and are worth are not fraudulent foods. Neither the digestion nor palatability of other fats fully equals that of butter, *nor do they promote growth as it does.*

All fats have some fixed fatty acids and some volatile ; one of the latter is peculiar to butter. When other fats than milk-fat are used (as beef-fat), they are usually flavored with some butter, also colored to resemble it. The color of butter is not significant. Much butter that is yellow is not rich, only artificially colored. Colorless unsalted butter is the most delicate and expensive. It requires the freshest production, as salt is a preservative. The flavor of butter is due to the effect of bacteria upon cream ; as the bacteria differ, so the flavor. Flavor is increasingly regulated by artificially "ripening" cream with bacteria selected to produce the flavor desired.

Oleomargarine or *butterine* is clarified beef-fat, often with cottonseed-oil too, churned in milk. It lacks casein or volatile fatty acids, so such characteristics of butter ; also is without its aroma. Oleomargarine serves some purposes wholesomely and many claim palatably. In cooking some think it indistinguishable, except in cake and candy. It makes cake heavy when used alone ; it fails to remain mixed in candy.

Renovated butter is rancid (or stale) butter remade by melting and pouring the fat off the casein that settles, then rechurning the fat. Such butter is improved, but is not the equivalent of fresh butter. Butter becomes rancid through changes in the casein or by the fats decomposing. Heating fat makes it less digestible.

Milk and its derivatives — cream, butter, cheese — are all dairy-products, but with growing specialization cheese has become a specific and elaborated industry.

Cheese is produced from milk by rennet precipitating the curd that carries with it fat, some salts, and even a little sugar. (Note composition, p. 114.) Common salt is added and coloring matter is usual. The curd is drained of the whey and ripened by the action of bacteria. The flavor desired is now produced by scientific selection of these ferments.

Cottage cheese is the simplest. It is the curd, often coagulated simply by heating, mixed with cream and seasoned. Neufchâtel is a sweet-milk cheese coagulated by rennet at high temperature; it is made especially soft and smooth by kneading. Such cheese is very digestible.

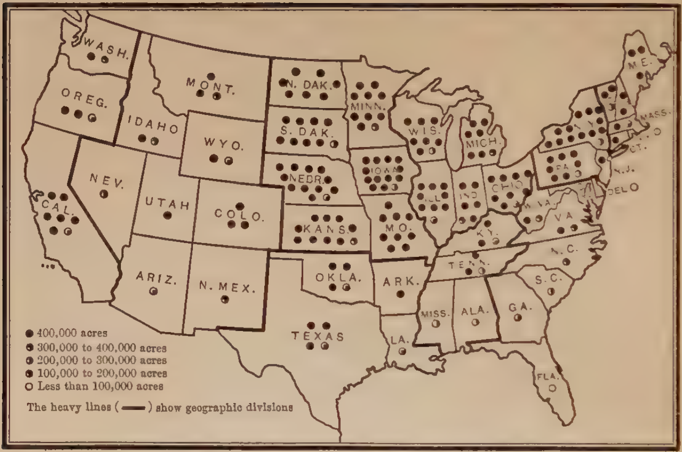
Some cheese contains mold, as Roquefort. It is goats' and ewes' milk and bread, ripened in caves. The mold distributes itself through the cheese, producing its distinctive taste and odor. Other cheese is flavored through some fungus growth penetrating it; such is Stilton. These are the richer kinds of cheese; they are less generally digestible.

Between these extremes are many very palatable and nutritious forms of cheese, variously prepared but differing mainly in flavor through the effect upon the milk of the bacteria used. Among these are Cheddar, Edam, Parmesan, Swiss, Sage.

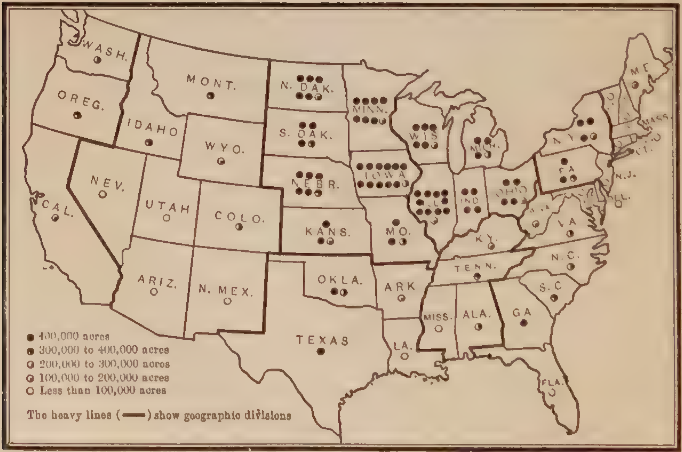
Adulteration of cheese is rarer than formerly. It consists in use of skim-milk and substitution of less expensive fats than that of milk. The resulting food called "filled" cheese may be wholesome, but it must now be sold for what it is and is worth. Harmless coloring matter is not forbidden.

Cheese is $\frac{1}{3}$ protein, $\frac{1}{3}$ fat, $\frac{1}{3}$ water; in small quantity with other food is an aid to digestion but itself digests slowly.

HAY AND FORAGE ACREAGE BY STATES — 1909

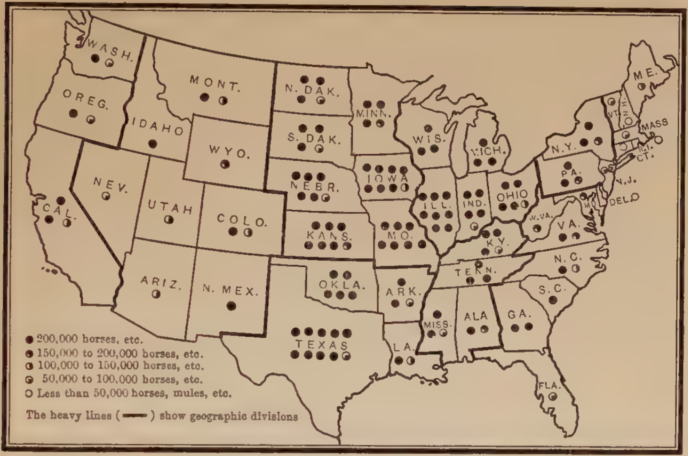


OATS ACREAGE BY STATES — 1909

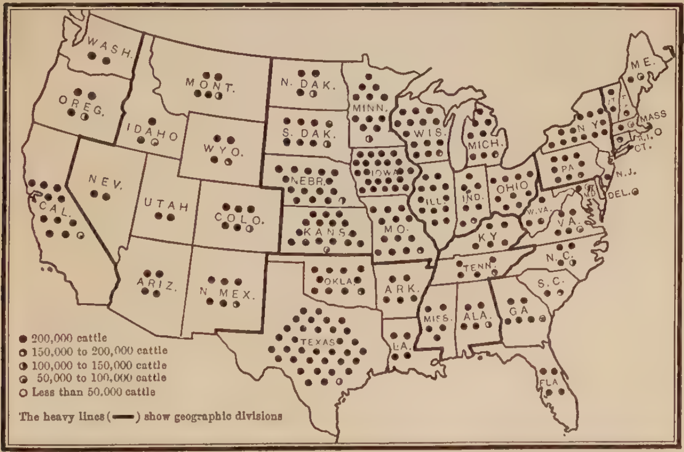


(From the Thirteenth Census of the United States, 1910)

HORSES AND OTHER WORK-ANIMALS ON FARMS — 1910

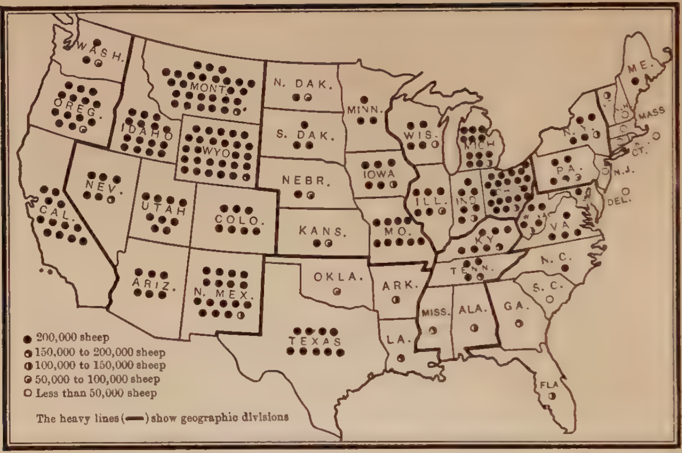


ALL CATTLE ON FARMS — 1910

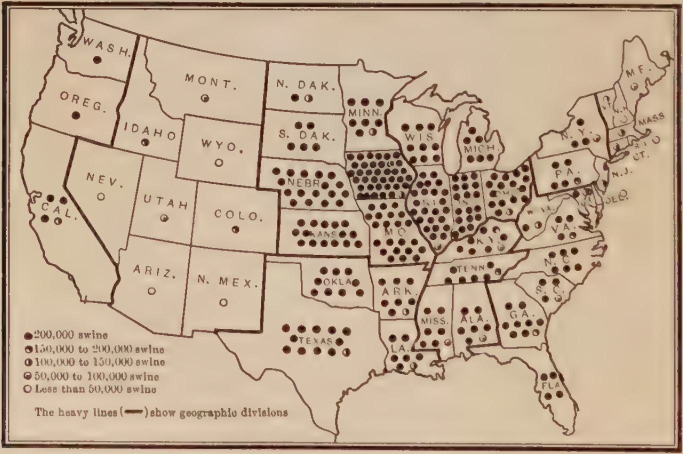


(From the Thirteenth Census of the United States, 1910)

ALL SHEEP ON FARMS — 1910

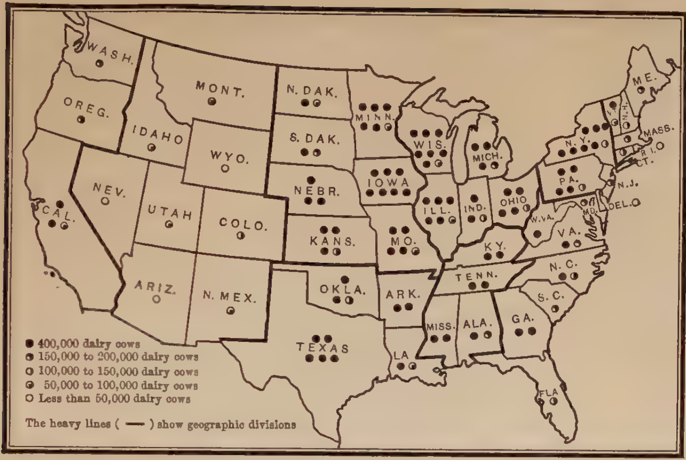


ALL SWINE ON FARMS — 1910

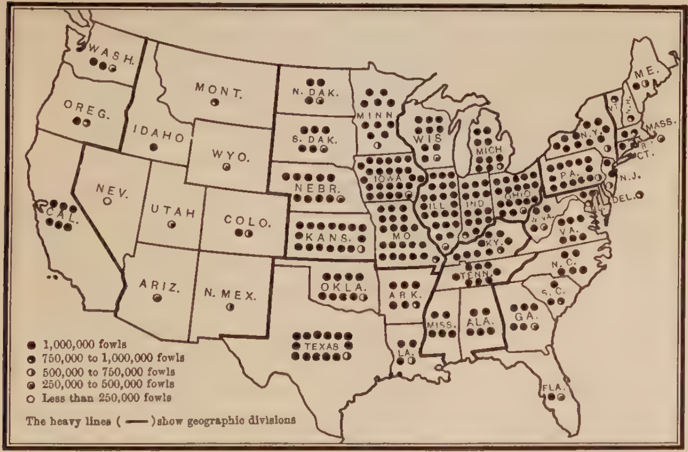


(From the Thirteenth Census of the United States, 1910)

DAIRY COWS ON FARMS — 1910



ALL FOWLS ON FARMS — 1910



(From the Thirteenth Census of the United States, 1910)

ANIMAL FOODS

Meat and Fish
Chicken and Eggs
Milk — Butter — Cheese

All build tissue and bone with protein and mineral salts and supply heat-energy with fats chiefly.

Animal foods are all high priced, though all are not equally so. Some fish and tougher cuts of meat are less expensive.

Cooking alters animal foods significantly. It often increases their palatability but usually lessens their digestibility.

Digestibility of animal foods is high — 95% and more.

Chicken — meats — eggs — fish Butter — milk — cheese	Order of digestibility from left to right

Time of digestion is often long, even when a food digests completely. Foods that are digested in the intestine are necessarily slow of digestion, because it takes some time for them even to reach the intestine. Eggs fail to excite a flow of gastric juice and must pass to the intestine before they are digested. Cheese too digests there, so is delayed. Eaten regularly and in small quantities with other foods it promotes their digestion; but eaten as a food intermittently it digests less generally experience shows, though laboratory experiments find it is finally totally soluble in the digestive juices. It has long been a valued work-food of Europe's workers.

Building foods are advised in less variety for the individual than vegetables, because if any do not digest, they leave dangerous waste products for the body to dispose of. Therefore those that prove fully available should be the choice in even maturity, and these not in excess of the body-need.

Pursuit of Food — Invasion
Production of Food — Invention
Manufacture of Food — Industry
Preparation of Food — Science

When humanity existed as one living group, human food consisted of roots, seeds, fruits. As the number of individuals increased, the means of subsistence became too limited. Humanity then began to separate into groups that scattered more and more over the surface of the earth in pursuit of food. Scientists that study human life to learn what it was like in the past, find that the ways of obtaining subsistence so differed at different times and among different groups as to mark somewhat different stages in the development of humanity itself.

Methods of production thus mark periods of growth of humanity as a whole. But development is never exactly together in any age or even fully so in any place at any time.

Humanity in its early life had not so fully emerged from its animal ancestry as to live on the ground as it now does. Humankind was then still tree-dwellers, ate roots and fruits, and began to speak articulated language. The next stage of development, marking changes that advance human life somewhat further, finds humankind eating fish and other small animals, having discovered fire, making weapons of wood and stone and using these in the hunt and war.

Neighboring groups contended for the food-sources and for the desirable locations for dwelling and hunting. They warred with one another for the actual things used in order to live, grow, develop. Then even cannibalism was practiced.

By working to live, creative effort developed. No longer was the sole occupation search for what existed which would sustain human life. Pursuit of sustenance was now furthered by manufacture of means to work with, as the bow and arrow. New uses were also developed for what humanity then had found. Implements of stone were made with which to produce as well as weapons to war, to prepare food as well as to hunt it, to protect or shelter as well as prospect or pursue what was desired. Mats and baskets were woven. The art of weaving was born.

As human living advanced further, pottery was invented, animals were domesticated, and other animal products besides meat began to be used. Milk became a food, furs were used to protect; agriculture developed; corn was cultivated in the west of the world; in the east all other grains were grown.

The east tended to increased domestication of animals, and the west to cultivation of plants that nourish. This required irrigation artificially produced. Building began with stones and bricks sun-dried. The caring for animals led to formation of herds and pastoral life among people. Thus more nourishment was needed for both animals and humanity. To produce it increased agriculture. Life became less wandering and warring and more sedentary and varied in manner of living. Cannibalism began to disappear. The energy spent earlier in *invasion* in search of supplies was passing into *invention* that aided in supplying living-needs from the resources of the environment.

Iron ore began to be melted and formed for uses it could serve. The plow and other implements, as the axe, spade, hoe, made less formidable the cultivation of the soil. Farming flourished as was impossible when humanity was less well equipped. This gave a renewed impulse to agriculture. Alphabetical writing had its origin at this stage of human advance.

The quest for food led to the conquest of nature, not to despoil nature, but to work with her to increase her fertility that she might produce what humanity needed to live, grow, reproduce, and develop. Such interworking of humanity and nature to produce enough to meet an increasing need for food still goes on. *Taking from nature, then from one another disappears before working with nature to provide for all. Growth in experience has resulted not only in expanding food and shelter but in extending human intelligence.*

As human intelligence has increased it has worked upon the problems presented by living. It has opened new opportunities to provide for and expand human life. Its progress has, however, not been an even advance, nor have all steps been forward.

Development of invention in the use of iron for implements, as aids to more effective work, gave an impulse to mental extension as well as control of work. Tools for building extended construction; wagons for travel and ships for sailing made exploration more possible as well as products more varied. As metals were found to be malleable, so could be wrought, the mechanical arts were born. Manufacture of arms and wall-protection of cities followed. Architecture arose.

And with alphabetical language now at command an interpretation and record of life began to take form in mythology, poetry, chronicle. The ideal imaginings, the emotions, the events, of human living were expressed. These products of writing appeared in the Orient and the countries encircling the Mediterranean sea — Egypt, Greece, Italy. In this humanity was giving new expression to its interests, while growing in facility in meeting the needs of physical living. Civilization superseded earlier stages of living; it permeated Europe and spread. Humanism is the new stage of race-life approaching.

* * *

Production — Manufacture — Distribution — Consumption are interwoven now with

Nature, Invention, Industry, Transportation, Commerce, Science and with Humanity as workers as well as consumers.

The work of providing food, together with the nourishment it necessitates, constitutes many modern problems of trade and labor as well as human nourishment and health. These are more and more coming under community consideration. So food as it is prepared together for all is becoming a concern of all.

Production of food on a large scale has been carried on for some centuries, but raising food for the use of others to be sold them for gain is not so old. With this has developed food-transportation, storage, commerce. The early search and strife for food and the later producing of it have passed for most of humanity into simply purchasing food.

Food-production for commercial distribution occupies many workers. Food industry that manufactures such foods as flour and sugar, and prepares such as cereals and canned foods of all kinds also engages many workers, as do too, all the processes of handling food not only in transportation but commercially in markets.

Science as it is known to-day has been developed within this century. For not more than fifty years has it been even somewhat generally understood and only now at all popularly known. Eons of life, ages of human development, and centuries of mental effort to understand the workings of nature preceded the scientific enlightenment of this age. Rapid movement is now everywhere made to use in living what is being learned. This is leading to changes that alter human life and affect the ways of living.

The study of food is one of the most recent, also most far-reaching effects of science upon human health. Human growth can be furthered by understanding living. The reproduction of nature's products and effects is more and more attempted artificially and more and more nearly approached, yet the reaction of the human body to artificial foods is not usually the same as to natural. This requires that the difference between the two be further studied and eliminated, or the use of natural foods be continued, if health, vigor, growth are to be promoted by food.

Where food is to be found and how it is obtained has, it was seen, changed from age to age. First, it was only where nature brought it forth spontaneously; such products are called indigenous. In early times those foods were used that were found growing wherever food was needed. Only primitive life knew so simple a method of nourishing humanity. Food was then limited to what was growing and as it grew.

Later humanity ate what it could grow wherever it lived. Food was then limited to what could be produced at hand. Since only what would grow naturally was then available, barrenness or fertility of soil determined what diet would be.

As humanity passed into more peaceable living and found itself living more fully over the surface of the earth in all climes and growing into interworking communication, it learned what grew everywhere. It has brought what grows from where it grows best to where it can be most used. This has extended transportation of food, with consequent storage of it. Variety in diet has thus been increased; freshness of food has been greatly decreased. More persons have become engaged in handling food than in producing it. Food has thus entered into the realm of profit as well as nourishment of humanity.

Science, in its study of food and feeding, first looked at what happened with animals and tried to see what could be done further for them. Recently science has been investigating the food-needs and food-possibilities for humanity. How the conditions that produce fertility can be effected where barrenness prevails is increasingly studied. As this is understood, it is used to bring more abundant and more varied food from the earth wherever there is human life in need of it. Science-direction and human work can now usually produce variety in food at hand. It is thus that freshness of food is insured.

Preparation of food has developed as has production. Like food-production, food-preparation is now studied. The methods of early times and those of every land are now more generally known and practiced. Many methods arising where a food so grows as to be a chief article of diet are carried with it as the people that first used it move from place to place, or as it is transported or more extensively cultivated, so more widely eaten.

Most early methods were developed by life-experience in preparing food. These are now found by scientific experiment to be ways of treating food-materials which make food not only more palatable but also usually more digestible and nutritious. Cooking — the application of dry or moist heat to food — changes different foods differently. Heat tends to break up and render tender vegetable fiber, whereas it toughens animal. Prolonged slow cooking of grains and rapid slight cooking of tender meats have always been practiced, because these foods when thus cooked seemed better. Science has now learned why.

Much that science has learned about the exact effect of different methods of treating different foods, together with the tendency toward factory production of all products needed for human consumption, has led to extensive preparation of food outside of the home. As the storage of food arose with the general transportation of it, so the preservation of food has arisen, likewise the practice of factory preparation. The advantage claimed for transported food has been variety of food everywhere at all seasons with less labor for the consumer; this is claimed also for factory-prepared food. The disadvantage of the former, namely decreased freshness, is the disadvantage of the latter. The distinct danger of each will be discussed elsewhere.

Food-transportation makes more food-traders than producers. Factory preparation decreases the preparers of food.

Home gardens and home cooking were once usual. They are now less common. Both are to be encouraged to provide fresh and wholesome food. Only in the country is the food-supply of the family now within the direct control of the home. Even there some foods come partially prepared. But selection of food still remains a home occupation. All need therefore to know in what condition food needs to be.

The industrial arms of society now bring much of the food a family eats from the farm and market through the factory and shop. What they bring and how they bring it is of importance to all; all are consumers. Many simply market food that others produce. More producers are needed.

In school all are now learning to be more fully self-helpful in all ways. How to care for one's self in living and how to produce what is needed for life are beginning to be taught everywhere. Much can now be known about human needs and how different communities meet these. Knowing what food is and does is an important part of such learning, because it is thus one knows what should be eaten and where and how to obtain it, prepare it, and use it.

Humanity is discovering what grows everywhere in the earth, water, air. What humanity can use for food is being eaten. What different foods do when eaten is being studied by science and learned by humanity.

A seed buried in the earth becomes a plant. Something has happened to that seed; usually some one has taken some care of it. Many plants are eaten as food. Something further then happens; the plant becomes food-energy and furthers life in other ways. The adult that eats suitable food can work and be strong.

Humanity could not live if it did not eat.

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AN ITALIAN KITCHEN

From Janet Ross's " Leaves from a Tuscan Kitchen."

Health is usually assumed as the natural state of humanity. In reality human health comes only by humanity's working with nature to keep the natural processes of physical living effectively active. To do this one must know what these are and what changes them. The use of such knowledge in living is health-nurture. Caring for life so it is wholesome and nourishing the body so it is well secure health to humanity.

Wholesome food and pure water and air; alternate rest and exercise; sanitary environment and hygienic habits; healthful clothing and housing; developing occupation and elevating recreation; human intercourse and community interests,—are all factors in producing enduring health. Proper adjustment of these to each other and for each person's needs is the problem of procuring health. Usually this is done without much consciousness that health demands attention. But if neglected, disastrous results ensue. No one is especially aware of health when he has it, but when gone it becomes one's chief concern. Time is saved and strength insured by making health-giving practices the habits of the body.

In order that there may be health, the supplies to the body — food, water, air — must be provided through informed intelligence. To learn what food is and does leads into learning how the body lives, and what it needs in order to live in health and grow into maturing power. Only thus can the person lead a developing and fully useful life.

Nature supplies heat, light, air, water, as it does food. But these all need adjustment to human life if they are to further rather than destroy it. Humanity survives by adjusting its environment to its needs. Freeing surroundings of ill influences and reënforcing all health-giving agencies make an environment of health-aids in which humanity can develop.

How foods are grown, handled, kept, prepared, used, served, affect human activity, health, growth. Different foods need different conditions. But all need special care in production and preservation until used. All require complete cleanliness as kept and handled from garden to table.

A market that looks and is clean at all times is essential for health. Protection of food from dust of streets, from refuse of all kinds, from insects (as flies and ants), from vermin (as mice and rats), and from diseased persons on farm, in market, at home, is a health-necessity. Dust, refuse, insects, vermin, ill persons, are disease-carriers.

Exposure to disease usually weakens general health even when it does not cause definite disease. Resisting disease-influences requires of the body unnecessary effort. This is added to that of living and working. Contaminated food has been in contact with disease-sources ; it is one of the greatest dangers to life. Unsound food is food that is itself in unwholesome condition ; it is a health-menace. Food is eaten to sustain life and promote living-activity. Its condition needs to be such that it can be a health-help, a strength-promoter, an energy-giver, and in childhood and youth also a growth-aid.

Fresh, sound food, free itself from contamination, must be kept apart from all that is not. Any moldy bread or fruit makes all near it unsafe, as does also all food-waste or waste products of living (as sewage) or of industry (as factory-refuse). Receptacles, wrappers, carts, cars, all need to be clean and thoroughly aired. House, shop, factory refrigerators, utensils, elevators, must likewise be well-aired and cleaned. Hands too need to be clean ; all that handle food as produced, prepared, or eaten. Lack of cleanliness invites illness ; unsound food undermines health ; contaminated food causes disease.

Cooking food destroys some disease-germs but not always all. It cannot be relied upon to purify impure food or freshen unsound food. Care alone, guided by science in production, preservation, transportation, manufacture, preparation, furnishes humankind with food that promotes human well-being.

Pure food, pure water, pure air, are needed for wholesome living. All are possible when it is known what makes these pure and that their purity is as important to human life as their plentifulness. It is only as these are pure for all of a community that they can assuredly be for any one in it. Disease anywhere easily passes to food, and through food takes health from those to whom such food goes.

Clean-appearing food may not always be pure food, as clear water may not be pure water. Pure food is clean food, so kept as to be sound without introducing non-food substances to preserve the food or improve its appearance without improving its quality, as does coating rice with glucose and talcum or using benzoate of soda in factory foods, such as canned tomatoes.

Storage of food may preserve freshness of appearance without preventing deterioration in quality. Low temperatures may delay development of bacteria, yet not destroy them. Bacteria are then left to grow when the food comes from storage. Temperatures even so low as probably to free food from such danger still may not have made inactive soluble ferments natural in foods themselves. Such ferments can cause fermentation at the lowered temperatures of cold storage or refrigerated freight. Food that has been stored long or traveled far is often decayed by such ferments. Food may become so in the home refrigerator when not used promptly.

Germ-life (bacteria and molds) abounds in refuse, vitiated air, contaminated water. These are disease-sources.

Adulteration of food is relatively modern. Home-grown, home-cooked food may lack purity through ignorance or neglect, but only industry-produced, factory-prepared, shop-served food is ever adulterated. An effort is always made to provide pure food when the purpose is human nutrition.

Food laws purpose to protect humanity against abuse of food for financial advantage. What science finds harmful, law forbids; what is in doubt, law usually permits. But there is increasing scientific direction of all that affects the food of humanity; also increasing law control.

Substances known to be dangerous to life, if added to food for any purpose, would be adulterants. Such additions are, however, not usual. Substances not themselves foods are still used, which are introduced to improve appearance, such as chemicals to keep canned peas or beans green or to permit prolonged keeping of food for gain. Law requires that the presence of most of these be stated on food-labels, such as talcum coating rice. Better health results from not eating even supposedly harmless substances if they are not human foods.

Lessening nutritive value of foods, as watering milk, is adulteration; adding to weight would also be. This is now more rare. Coloring or thickening to pretend a quality not possessed by the food is food-adulteration, too. Such is thickening cream with gelatin or producing seeming freshness in stale food by chemicals, as change of color in meat, or preventing by chemicals natural changes in food, as the souring of milk. Substitutions in commercially prepared foods as chicory in ground coffee, food laws prohibit; also concealed substitution of a cheaper food-ingredient of equivalent use, even if itself not unwholesome, for a more expensive, such as glucose for sugar in candies, oleomargarine for butter, cottonseed-oil for olive-oil.

Food-labels come into important connection with human nourishment through industrial food-production, preservation, preparation. When food was home-grown, cared for at home, and cooked there, what it was, what its condition was, and how it was changed for human use was naturally known, and the food itself was used in a relatively natural state. Avoid non-food ingredients. Overripe and overkept foods may endanger life and do undermine health.

But with the extension of food products through ages of living and with the application of developing science and the dissemination of provisions used by humanity for its sustenance, industry has entered the home significantly. It has become largely responsible for the supplies of the home. Industry is now expected to indicate what it is offering on the labels that law usually requires. *Read food-labels.*

The facts may be accurately stated, yet the purchaser be misled. This is possible mainly because of ignorance on the part of the consumer that buys. The composition of a food may be similar to that of another valued food, still not be of like value as a human food. It is sometimes stated in advertisements that rice contains a percentage of food-building substance (protein) equivalent to that in a pound of meat. But this does not make rice a food substitute for meat, because for the same weight they differ greatly in bulk when cooked. Rice expands, taking up water; meat shrinks, losing water. Meat and rice also differ in the other constituents they contain; these differ in their use in the body. Only knowledge of *all the facts* about foods insures a satisfactory choice.

Labels state what law exacts and what will stimulate sales. Statement is required of addition to food, but not always of the quality and composition of the food. *Know food laws.*

Effort to sell leads to advice from sellers. It takes form in advertisement. Such announcement seeks to secure the response desired, usually purchase of something sold for profit. As the purpose is to commend what is for sale, what can be said in favor of proffered products is said. All facts may not be published, due partly to lack of space, sometimes for other reasons too. Laws guarantee nothing; they only require certain conditions to be maintained.

A manufacturer may state such requirements have been complied with and stop there or he may add what he thinks desirable to be known. Lentils are a chief article of diet of some European workers, as is often advertised. That does not, however, commend their like use where the dietary may be varied by freshly prepared foods as desirable themselves, as are peas and beans, especially if the lentils come canned.

Artificially compounded foods may have only such constituents as are permitted by law, but if what these are and what they come from is not known, no one can be intelligently fed who uses them. That a food of unknown origin serves a cooking-purpose, as a fat that heats without burning, is not enough to know about any food. Science seeks to understand the secrets of nature; these it discloses to humanity for its more competent living, not to compound secret foods for human consumption. What is not said in advertisements is often more important than what is. Ask for this too.

"Pure food" as a trade term means only not adulterated in the eyes of the prevailing law. Legally, "pure food" is not a recommendation; it is only a precaution against foods known to be unsafe; it does not in itself make any food an essentially *desirable human food*. Desirable foods are legally pure, but also assuredly clean, wholesome, and nourishing.

Understanding what food is and does can prevent all food-dangers; nothing else can. Such knowledge makes clear what is said about food; nothing else does. As science has increased what is known, learning about living has become more complex, but it is also more interesting and of greater value to human life. The necessity to know how to live wholesomely has increased with modern civilization. Human development depends upon the life-supplies' being those human life itself demands for living, growing, working. Food-production needs to be of the provisions human living can flourish upon, and distribution such as will reach all humanity.

Saving by buying what will not nourish costs human health, efficiency, and sometimes life itself. Living requires what fosters life; this known, secured, and utilized builds up humanity by insuring to it health, growth, energy, capability. What is said about anything that is to be used to sustain human life must be tested by what it will actually do to humanity. *Food has just one human use, that is, to nourish the body.* What foods should be used is determined by their actual usefulness in the living-economy of the body itself. Nothing is saved by trying to use what does not do what the body needs to have done for it by food.

It is the complete utilization of the foods that are really nourishing which is the only saving that can be practiced with profit to human life. Desirable foods are not all equally expensive nor of the same expense at all seasons. Undesirable foods used to save time, effort, or money are the most expensive to life and working-power. Choose the foods of greatest use to the body and use these fully. This is true saving, and the only safe saving, as is not the endeavor to save that might lead to practices that deprive humanity of needed nourishment.

Wholesome food is undiseased, uncontaminated, unadulterated. Plants and animals that furnish human food need health themselves. For this they require themselves proper and plentiful food, fresh air, uncontaminated water, cleanliness of surroundings, protection from weather blights of cold or drought or violence, and intelligent care as they are produced, transported, marketed, prepared, served.

Plants poorly nourished make inferior food; diseased plants make dangerous food. Poorly cared-for grain foods cause disease instead of furthering health. Quality of soils and science-methods of production are garden problems, but only as these are known and used to grow well plants can humanity be fed with wholesome vegetables. The part of the plant used for food and the way it is used determine somewhat the care needed in growing and keeping it.

Animals poorly fed and living under unsanitary conditions are not healthy, therefore cannot provide wholesome human food. Food-inspection is expected to regulate the condition of meats marketed. Not only diseased parts, but any part of an animal that is in any way diseased is unsafe for food. All meat eaten must be from undiseased animals and must not be stored for a long time.

Freezing and thawing change foods undesirably. Substances unfavorable to human life may be left in foods in which bacteria have grown, even after the bacteria are themselves destroyed. Some germs only delay their development at low temperatures. Natural ferments change foods in unpropitious ways not readily revealed to the senses. Hence the necessity of scientific examination of foods that are transported or stored and of legal regulation to procure a wholesome food-supply for humanity.

Natural state of food once meant as it grew wild; it now means as food is cultivated. Many foods are now still further modified. Some are commonly used as food-ingredients, as are sugar, fats, grain flours.

Scientific examination of all foods and food-modifications is necessary. This is not simply to detect impurity. Effort to make food finer as a refinement of civilized life does not always produce a better food-product. Polishing rice has resulted in depriving it of some salts it naturally contains and the body needs. These withheld endanger health. What natural elements of food are left in, or what are taken out, affects significantly human health. What is taken out of food in manufacture is as important as what is put in. Law recognizes this less, but human health is no less affected by it, even when the cause is not known. Science finds facts; law directs acts.

Grains naturally contain some substances the body needs which are so arranged physically in grains that to keep them in food is to keep also coarse particles that the human body cannot digest. Even its opportunity to digest other food may be somewhat lessened by the presence of such particles, for these may quickly pass through the digestive tract and carry with them all food present in it, even that which needs to be retained for use. Bran in flour serves a health-purpose by aiding in freeing the body of food-waste. It is not itself nourishing. Food-scientists now doubt whether the salts associated with it are released for food-use in the body.

Science studies food and food-effects; what it finds it tells. Industry is more and more expected to do what human life needs done.' Communities more and more select scientifically equipped persons to direct food-production in the interest of human well-being.

CANNED FOOD INDUSTRY

Canning food was originally practiced to secure variety by keeping thus for out-of-season use such foods as could not be kept either fresh or dried. It has been extended in order to prepare food easily and quickly. Scientific canning may produce safe food. Canned food is, however, usually somewhat less desirable than freshly prepared and is rarely so palatable. Different foods differ in desirability when canned. Many lose their flavor. A few though changed are still very acceptable; tomatoes are, when good tomatoes have been used.

Dried vegetables, as beans and peas, though still used, as they should be, are less usual than of old. They are largely superseded by canned foods, as canned are beginning to be by transported. Transporting foods from all climes brings them in their natural state at most seasons. Dried foods lose water mainly; canned, some flavor; transported wilt and are often open to contamination. Delayed use of any type has dangers. Garden freshness brings health.

Preserved meats usually contain some addition of natural or artificial preservatives, as meat is not easily kept by cooking and sealing. It is dried, smoked, salted, corned, pickled, covered with oil, refrigerated, or frozen.

Dangers of canned foods are deterioration in quality and, if kept long, possible formation of undesirable substances; hence the advisability of dating all canned foods. Law does not as yet require this. Acid foods in tin may form dangerous compounds if carelessly canned, overkept, or permitted to stand in cans after opened. Canning makes possible many inferior food-substitutes that high seasoning conceals; hence the necessity of using only reliable brands. Overripe fruits and vegetables and undesirable meats can be sold canned which would not otherwise be salable.

Food products have rarely been used simply as taken from nature. Fresh vegetables, fruits, and milk are the only common foods now so used; even these are also eaten in many prepared forms. Canned foods are usually cooked and sealed. Sometimes they have, however, simply had the air excluded, as blueberries sealed in water, for use at sea, where they are taken to prevent disease caused by lack of food-salts.

Manufactured foods are not all cooked or canned. Some are only milled, as are most grains that are used as flours or meals. Grains must be in wholesome condition themselves, be ground under sanitary conditions, and kept clean and dry, to produce health-giving foods.

Originally only such foods were sold manufactured as would not otherwise be edible. Sugar and molasses have so long been used as manufactured foods that they are commonly accepted as natural in this state and the processes used to produce them are generally unfamiliar. Butter and cheese, though once home-produced, are now usually bought without thought as to their derivation. Jams and jellies from fruits, and soups from meats and vegetables, appear now as manufactured products for sale, but these are still also often home-made.

Foods of concealed composition are, as noted, beginning to appear. These must satisfy law standards for food. That a substance has the composition and characteristics that serve a given food-purpose does not essentially make it an acceptable article of diet. Oils made from food-refuse and called "salad" oil make little appeal to those that know their origin. Even cottonseed-oil needs to be known and sold as itself rather than as "salad" oil charged for as olive-oil.

Use food of which the composition can be entirely known and the process of its manufacture fully seen.

All foods are beginning to be sold by weight. This is most desirable. Food of good quality bought thus enables one to know accurately what is obtained, also to learn more easily how much is eaten. It is advisable in buying to know what different quantities of different foods weigh; as,

1 pk. of peas weighs about 6 lb., and 3 lb. yield about 1 lb. shelled. At 50¢ a peck they then cost 25¢ per pound shelled. (This is buying at the highest price and in small quantity.) Canned peas cost 15¢ to 30¢ (according to quality) and weigh 1 lb. Do fresh or canned peas cost more?

Many foods are usually sold by box or basket at a stated price for all. Too frequently these are not of even quality or degree of freshness. Fresh and stale food should not be sold mixed; they are not of the same value. Even when sold at an averaged price, such mixing is undesirable. They do not cook evenly. Fresh string-beans, for example, may cook in 20 to 30 min. Those traveled and held require 1½ to 3 hours.

Such practices as using sound, ripe tomatoes for top rows on boxes of those less acceptable should be discouraged. It is not thus that a good food-supply at fair cost is insured to a community. Packing food in movable trays (paper or other) aids in inspection. Food-quality always needs to be known. See what is bought; buy what is good; keep food well and use fully.

Some foods may be home-stored if house space is available at suitable temperature with pure atmosphere and sanitary care. Flour is desirable by the barrel when it can be kept dry and away from all animal life. Potatoes may be stored by the barrel for winter use when they can be kept cool and dark, with air excluded. Few foods will, however, keep in hot apartment-houses. Though small buying is higher and to be avoided, wasteful use is no more economical. Three for 25 cents is not wise, saving buying, if only one is used or is superior.

Home testing of food-quality is still somewhat useful. But to insure satisfactory quality and full quantity more adequate community regulation of the quality of all food for all of humanity is the modern necessity. It is well to know that *butter when pure boils quietly*. But when all butter is sold for what it is, it will not need to be tested after it is bought. Testing should precede placing food on sale. When on sale the facts of the test should be stated as commonly and clearly as the price.

Selling food for its *real quality* and its *actual quantity* needs to be made the universal practice. Human life and efficiency require that such care be exercised in obtaining human food. Chicory in coffee can be detected at home. " Broken " eggs in bakery-products cannot be detected by home tests. Yet the human body experiences the disadvantage of consuming unfit food. Only investigation of raw food-materials reveals many modern food-deteriorations that entail illness not always easily traced to this cause. Inferior ingredients cannot make superior foods or even reliable. Supervision of what is used by those that know what should be eaten, will alone make compounded foods safe and wholesome. Intelligent use cannot be made of foods of concealed origin, manufacture, or composition.

What cannot be tested, as " broken " eggs, in food, together with what cannot be known by the consumer, as that a food oil has been shipped in a kerosene-barrel, the community must be responsible for preventing. Otherwise the discovery is left to be made by the illness of those so fed. All that know the need (and all should know it) must aid in securing the kind of investigation and supervision of food-preparation that the extension of food-industry now makes necessary, because home testing cannot reach the dangers, and human digestion cannot deal with products not digestible by the body.

Natural foods were originally simply nature-produced. By the aid of humankind cultivated and manufactured foods have become natural as foods in so far as they have become usual and humankind has become adjusted to their use. All modification of food to improve it as human food is to be encouraged, but is to be distinguished from changes in foods to increase profit rather than to improve their nourishing properties.

The tendency to-day in artificial changes in food is commercial rather than nutritive. Knowledge of food and its use to the human body should direct both the selection of food and the regulation of its production.

Some scientists claim that artificially prepared substances that are chemically the same as food-substances are satisfactory food-substitutes, and that they may be made even more free from substances undesirable in food than are natural foods. Others think not. But all are agreed that such is not yet the practice, and that science has as yet been used more in the service of profit than in purifying food. Constructed foods are now on the market; such are some fruit-flavors.

The use of by-products of manufacture for food has introduced cottonseed-oil, glucose, and other substances that chemically are the equivalent of foods long in use. When made of wholesome materials and by means of sanitary processes such foods are not objectionable, though they rarely are as palatable as are foods more directly produced by nature. They often are not so generally digestible.

Foods constructed to deceive, through a desire to save expense in order to increase profit, may be dangerous to health. Jams made of fruit-pulp discarded from jelly-making and colored artificially cannot be nutritious nor can catsup made of woody-fiber vegetables and colored red with aniline dyes.

Preservatives are old in use and are used to keep food as natural as possible. Originally this was practiced for out-of-season use of seasonally produced food, where the supply of food was limited. The substances used were those also used for condiments, as vinegar, alcohol, spices, salt. Smoking too was practiced; it preserves, because smoke contains creosote that is a germicide and that is so used as a drug.

Why preservatives did preserve food was long unknown. But with the discovery of bacteria came a knowledge of the cause of decomposition that is generally recognized as putrefaction or decaying of food. To overcome such changes they were studied. It has been found that only a few kinds of bacteria cause these changes. Extremes of temperature (see Sterilization, p. 152) are unfavorable to the growth of such bacteria, as are also many chemicals.

Modern chemical preservatives, refrigeration, sterilization, are used mainly for their effect upon these putrefactive bacteria, in order to prevent unpleasant tastes and odors. Some of the chemicals used are borax or boric acid, benzoate of soda, formaldehyde, sulphites, hydrogen peroxid. None of these are foods. Some that have been found not to injure healthy adults have affected young animals seriously, and are not advised even when not forbidden by law. For children, invalids, and the aged they may be perilous; for any one they may cause kidney-deterioration, so later disease. Sulphites, used to make meat red, cause hemorrhages of different organs. Hydrogen peroxid is not considered unsafe; when added to food it breaks up quickly into simply water and oxygen. But oxygen as it is being thus freed from chemical combination is particularly destructive to bacterial life; also to tissues, therefore is claimed by some to affect unfavorably the food-quality.

With widely distributed production, transportation, storage, preservation, and factory preparation of food, keeping food has grown to be an important problem that needs to be solved for all humanity. Fortunately both science and government are seriously concerning themselves with this problem. The interpretation of the laws regulating the practices in the preservation of food is also coming under closer consideration.

The attorney general of the United States is quoted as saying in a specific instance regarding food-purity :

> If minute quantities of nitrites may be added to flour, of boric acid to eggs, of chromate of lead to the coffee-bean, of sulphate of copper to peas, of arsenic or lead to baking-powder, of Martin's yellow to macaroni, of wood-alcohol to flavoring-extracts, so long as it is not probable that enough in each case has been added possibly to injure health of some one, then the statute is incapable of enforcement. If actual injury must be shown, what standard of resistance is to be adopted? Will it be that of the sickly infant or that of the strong man?

Bleaching and dyeing foods to improve their appearance as well as preservatives, bring into foods substances foreign to them, which do not always affect favorably either the foods or the persons that consume foods so treated. Sulphites are used to bleach asparagus and other light-colored vegetables and fruits, also flours and sugar.

Dyes may be those natural in vegetable food which have been extracted to be so used. But food-dyes may also be aniline dyes made from coal-tar products. None of the latter are foods. Some are considered harmless ; others are known to be poisonous. The government forbids use of the latter. Coloring food is to-day common. Confections are generally artificially colored ; even canned tomatoes have been found to be.

Reliable sources of supply, scientifically regulated, are essential for safe foods, especially when preserved, bleached, or dyed.

Pleasing appearance in food needs to be effected through care of the product and not by artificially concealing its defects or by rendering the food itself defective. Manufactured foods are open to both dangers. Graham flour, in retaining bran, needs more special care to be clean than other flours that are essentially free from all scourings.

Rice when polished loses salts without which the body may develop nervous disorder of a serious nature (beriberi). Where rice is a chief article of diet, polishing it may become a menace ; it is always a danger. Rice is, however, not to be avoided, but to be secured unpolished and uncoated. It is its quality, not appearance, that affects human health. Corn meal, a common, nutritious, cheap food, may cause devitalizing disease (through malnutrition) when it is produced or ground under unsanitary conditions or kept under such.

Ignorance or neglect may make foods unwholesome. Craft in commerce may, too. Whatever the cause of unfit food — be it non-food preservatives, unsafe dyes, crude by-products, artificial additions for appearance or as concealed substitutions in food, or chemically constructed foods instead of nature-grown — in so far as it is unfit it cannot nourish. Such food is more than valueless ; it is a dangerous food-burden.

Bacteria in food cause general deterioration and often specific disease. Meat and milk change so easily that only the greatest care keeps them safe foods. Water is open to so many sources of contamination that to insure its purity requires great care. Fats are less readily affected by bacteria, so do not deteriorate as easily. Green vegetables are more apt to carry bacteria of the soil and dust than themselves to deteriorate through the presence of these. Starchy vegetables uncooked do not readily support bacterial life, so do not deteriorate promptly.

Sterile food is food free from bacteria of all kinds. Sterilization of food is therefore destroying all bacteria. Dry heat at 350°+ F., steam (moist heat) under pressure, and some chemicals will kill bacteria. The chemicals that will do this would, however, render a food unfit for human use, so heat must be relied upon to sterilize food. The process of rendering food sterile by heat is known as sterilization. The degree of heat necessary may decrease the palatability of many foods, also even the nutritiousness of some. Sterilized milk is less palatable than raw; fats raised to high temperature decompose; sugar changes its form. But such foods as can be sterilized are thus made safe, if not reëxposed after being sterilized.

To prevent destruction of a food and yet its deterioration, less intense heat is used. This, however, only checks bacterial growth without destroying the bacteria that may develop later under more favorable conditions for their life. Freezing acts similarly. Bacteria that cause human disease may resist effectively extremes of temperature, either high or low, moist or dry. It is therefore only such as affect the food itself (putrefactive bacteria), not the person directly (as do pathogenic or disease-producing bacteria), which cooking and freezing food destroy or even significantly delay in their activity.

Keeping food clean lessens contamination; cooking it usually decreases the germs it contains; cooling it delays its decomposition. Food requires continuous freedom from contamination. Even when food is to be sterilized, as in canning, it is still important to keep it sound and otherwise free from contamination. Food in which bacteria have grown is not freed of the effects of their growth by later sterilization. Ptomaines, for instance, are chemical substances formed by bacterial growth.

Refrigeration of food is its preservation by lowering the temperature below that favorable for bacterial growth. Though this temperature varies for different kinds of bacteria, it is generally true that freezing or temperatures near it are unpropitious for bacteria. The disease-producing bacteria that attack persons for food grow best at the temperature of the body ($98\frac{2}{5}$° F.). But some of these have spore-forms that resist destruction by anything except extremely high heat continued for some time, or chemicals dangerous to human life. Frozen or refrigerated foods may therefore contain such bacteria in live form, that will develop when taken into the human body. Hence the imperative necessity of keeping foods free from contamination which are to be preserved through freezing or refrigeration. Impure water does not form pure ice.

The bacteria that attack foods for their own food (that is, putrefactive bacteria that cause food-decomposition), though also affected by cold as are the disease-producing (pathogenic) bacteria, are also not assuredly destroyed by cold. Some putrefactive bacteria remain somewhat active at low temperatures and cause food-deterioration during this form of preservation. The refreezing of frozen mixtures, such as ice-creams, or the use of such foods for food-ingredients when melted, as melted ice-cream in cake, is inadvisable and may even be dangerous. Freezing and thawing may change the composition of some foods. It usually increases the probability of prompt decay, even when it does not cause partial decomposition. Some substances, known as unorganized ferments, remain active at low temperatures at which food is kept; these may change the composition of the food undesirably.

Cold storage in market and transportation and refrigeration in the house are alike in principle, though the devices differ.

Vegetables in season, animals in health, are wholesome natural foods. Scientific care that seeks food-preservation and preparation that secures wholesome human foods and not simply products passable for sale, aid in nourishing humankind effectively. Food-deteriorations and dangers are increasingly prevented by food-inspection and law-regulation through scientifically trained community-commissions.

All food must be sound to be safe. Knowledge protects, for care must be intelligent to prevent exposure of food, so wasting it and starving the body or endangering health.

The effects of decomposition do not disappear when the food (as decomposed fish) is heated or frozen. Dried foods, though they do not foster activity of bacteria, because most germs require moisture, will permit later development so soon as moistened for use.

All foods do not equally provide food for bacteria. Cane-sugar, salt, oil, and food-acids, as vinegar, are less favorable to their growth than are other foods.

Canned food gives variety where the natural food-supply is necessarily limited. Every one needs pure, wholesome food all the time. Children and invalids *must* have it.

Ptomaine poisoning from hotel fare (Dr. Schrumpf's warning). Asparagus, canned goods, beans, may cause ptomaine poisoning unless in the best condition. Reserving food increases the danger. Fish should not be eaten at inland hotels in warm weather, as it is difficult to keep it in proper condition for use. Chronic ptomaine poisoning may result from eating it. All high seasoning of food is to be avoided, as it conceals food-quality. Fresh food material is to be preferred to length of menu. A continued intake of minute amounts of ptomaines causes loss of appetite, flatulency, constipation; or palpitations, dizziness; or nervous restlessness, headache, insomnia, depression.

Many chemicals harmful in large quantity are used in small. Though ill results may not be detected, there is reason to doubt whether constant consumption of even small quantities is not ultimately harmful, especially as those that eat any foods so treated usually eat many. Such food-dangers are to be avoided.

Dangerous residues in food of chemicals added, or of any created by bacterial life, and deterioration of food-quality through the effect of these, are the dangers of commercial food-preservation and food-storage and of home delay in use of food.

Different kinds of food need to be kept apart. Some give off odors ; fruits do. Others absorb odors ; milk and butter do, and have their own flavors destroyed thus. Cold compartments need to be aired and kept completely clean.

Though cooking usually destroys bacteria, cooked starchy foods such as potatoes are decomposed more readily than uncooked, as cooked (not raw) starch readily supports germ-life.

Refrigeration retards decay and reinstates appearance of freshness. Cooled air (about 40° F.) is circulated around whatever is to be preserved from decomposition, or kept fresh, or freshened by cold. See pp. 220–221.

Ripening of fruit is affected by heat, moisture, air, and light. By control of these it may be hastened or delayed. Some fruits, as apples, may be kept in ripened condition for a number of months. Others, as bananas, may be stored green and allowed to ripen in storage. This is possible because many of the changes in ripening are carried on by unorganized ferments (or enzymes) in the fruit. If this is too long continued, the overripe fruit becomes unfit food. Fruits in storage are living. They consume oxygen and produce carbon dioxid. As this happens, part of their carbohydrate is oxidized and heat is generated.

AVERAGE COST OF FOOD PER WORKING MAN'S FAMILY

	N. ATLANTIC	S. ATLANTIC	N. CENTRAL	S. CENTRAL	WESTERN	U.S.A.
1897	$312	$271	$289	$266	$286	$299
1907	385	341	367	341	358	374

(Statistical Abstract of the United States, 1910) (According to geographical divisions)

PURCHASING POWER OF WEEKLY WAGE PER WORKER

Decreased 1.5% from 1897 to 1907 and was .9% less than in 1906 (measured by retail prices of food).

INCREASE IN WHOLESALE AND RETAIL PRICES FROM 1897 TO 1907

Wholesale food-prices averaged ⅓ higher in 1907 than 1897
Retail food-prices averaged ¼ higher in 1907 than 1897

SPECIFIC INCREASE IN RETAIL PRICES OF STAPLE FOODS

	PRICE INCREASE, 1897–1907	RELATIVE INCREASE IN 1910 OVER AVERAGE FOR 1890–1899 = 100		PRICE INCREASE, 1897–1907	
	%	%	%	%	
Eggs	50.7	137.7	116.8	17.2	Milk
Chicken	39.8	131.4	120.6	20.4	Beef, steaks
Butter	37.1	127.6	119.1	18.7	Roasts
Cheese	39.8	123.2	114.1	13.1	Salted
Lard	49.4	134.2	125.	25.1	Veal
Pork, fresh	45.	142.5	120.6	20.8	Fish (fresh)
Salt (bacon)	61.5	157.3	121.6	27.7	Fish (salt)
Salt (dry)	45.1	141.2	96.	4.1	Sugar
Ham	33.1	130.7	107.7	10.2	Molasses
Mutton	30.6	130.1	104.5	7.3	Vinegar
Potatoes	29.7	120.6	105.3	6.9	Tea
Cornmeal	40.4	131.6	95.	.4	Coffee
Beans (dry)	29.8	118.8	108.5	10.8	Rice
Apples	41.9	124.6	104.5	4.5	Bread
(Evaporated)			117.7	12.8	Flour
			88.4	4.9	Prunes

(Corn meal, in 1907 *production and consumption* larger than either before or since, yet price increased 40% over 1897 and 31.6% over average in 1890–1899)

INCREASE IN WHOLESALE PRICES OF LIVING-COMMODITIES

(Relative price as compared with average for 1890–1899)

		INCREASE IN 1910 OVER YEAR GIVEN	1910		INCREASE IN 1910 OVER YEAR GIVEN		
	%	%	%	%	%	%	
Farm-products (1896)	78.3	110.2	164.6	125.4	48.7	86.4	(1898) Metals, implements
Food (1896)	83.8	53.6	128.7	128.5	69.5	90.4	(1897) Building-lumber
Drugs, chemicals (1895)	87.9	33.1	117.	111.6	24.3	89.8	(1897) Furnishings (house)
Fuel, lighting (1894)	91.4	35.7	125.4	133.1	45.6	91.4	(1896) Miscellanies
Cloths, clothing (1897)	91.1	35.8	123.7	131.6	46.7	89.7	(1897) All commodities

(All data given or used in computations are from Statistical Abstract of the United States, 1910)

IMPORTATIONS AND % DUTY ON OTHER ARTICLES THAN FOOD

IN 1911	VALUE	AVERAGE RATE OF DUTY		VALUE	IN 1911
		%	%		
Cotton	$64,270,892	55.71	58.34	$11,431,652	China
Wool	18,791,076	87.72	55.12	6,639,142	Glass
(Unmanufactured)	29,572,259	42.20	29.13	15,236,699	Paper
Silk	31,965,625	53.47	38.85	52,692,318	Fibers
Furs	8,058,688	26.24	9.94	3,606,042	(Unmanufactured)
Jewelry, stones	32,990,527	14.18	32.35	14,934,247	Leather
Liquors			22.22	1,958,583	Paints
(wines, spirits)	18,546,026	89.85	11.76	35,657,953	Woods
Tobacco	29,788,180	87.82	35.	8,158,941	Toys
			31.63	22,119,753	Iron and steel

(Compare duties and importation above, also p. 158. For domestic production see pp. 186–187)

UNITED STATES IN 1911	EXPORTS	IMPORTS		EXPORTS	
	%	%	%	%	
Europe	63.84	50.3	13.98	4.17	Asia
North America	22.3	20.	1.98	3.22	Oceania
South America	5.32	11.96	1.78	1.15	Africa

Typical foods in quantities produced, imported, exported, consumed.

DOMESTIC PRODUCTS

	PRODUCED (BUSHELS)	IMPORTED (BUSHELS)	CONSUMED (BUSHELS)	EXPORTED (BUSHELS)	EX-PORTED
Corn					%
1907	2,927,414,091	10,184	2,841,058,047	86,368,228	2.95
1911	2,886,260,000	52,569	2,820,698,047	65,614,522	2.27
Wheat					
1907	735,260,970	590,092	588,551,205	146,700,425 (domestic) 599,432 (foreign)	19.95
1911	635,121,000	1,142,558	566,954,401	565,809,240 (domestic) 1,397 (foreign)	10.91

(Wheat exported in 1907, as grain ½ +, as flour ½ −; in 1911, ⅓ + as grain, ⅔ − as flour)

FOREIGN PRODUCTS

	IMPORTS (POUNDS)	VALUE	FOREIGN EXPORTS (LB.)	VALUE	AVE. PRICE	LB. USED PER CAPITA
Tea						
1907	86,368,490	$13,915,544	1,520,229	$207,094	16.1¢	.96
1911	102,653,942	17,613,569	3,287,366	447,304	17.2¢	1.04
Coffee						
1907	986,595,923	78,382,823	11,626,599	1,293,184	7.9¢	11.17
1911	878,322,468	90,949,963	8,457,003	1,096,052	10.3¢	9.27

(Less coffee and more tea used in 1911 than 1907. Price of each rose, though both duty-free)

DUTIABLE ARTICLES OF FOOD IMPORTED FOR CONSUMPTION IN 1911

IN 1911	VALUE	AVERAGE RATE OF DUTY		VALUE	IN 1911
		%	%		
Animals	$3,491,030	25.96	31.35	$9,266,094	Vegetables
Meats and			35.03	4,163,113	Rice
dairy-products	11,261,639	28.13	53.95	97,872,117	Sugar
Fish	12,915,830	19.2	36.7	21,843,214	Fruits and nuts
Oils (not all food oils)	12,307,223	27.65	31.56	11,729,802	Breadstuffs
Drugs, dyes, and chemicals	32,614,967	22.07			

(Free-list under consideration for 1913 includes cattle, meats, wheat, and flour, but only from countries extending same commercial privileges to the United States)

World-wide study of food-production, diet-habits, and food-needs has been in progress for the past two decades. Physiologists have been interesting themselves as never before in experimental study of human nutrition. General observational study of the dietary of different nations has also become more widespread.

It has been found that under the same conditions of living approximately the same food-constituents are consumed, and in the same relative amounts, the world over; but they are often obtained from different foods in different lands according to the food-production of the various countries. In France, for instance, liberal use is made of bread.

France has just concluded a study of the diet of its people.

(*Paris, France, for nearly 3,000,000 persons during 20 yrs. Computed by A. Gautier*)

FRENCH DAILY DIET (In grams; average from investigation noted above)

VEGETABLE							ANIMAL					INORGANIC	
Bread	*Green vegetables*	*Potatoes*	*Cereals*	*Sugar*	*Fruits*	*Wines etc.*	*Meat*	*Eggs*	*Cheese*	*Butter and oil*	*Milk*	*Salt*	*Water*
420	250	100	40	40	70	432	200	24	8	28	213	20	950

FOOD-CONSTITUENTS IN THE FOODS CONSUMED

PROTEIN	FATS	CARBOHYDRATES	CALORIES (heat-energy units in foods)
97 gm.	58 gm.	418 gm.	2500 +

GENERAL AVERAGE STANDARD FOR MAN AT MODERATE WORK

PROTEIN	FATS	CARBOHYDRATES	CALORIES
100 gm.	100 gm.	300–350 gm.	2500–2700 —

Compare number of grams of food-constituents in French dietary with general standard.

Production of food, specific foods, food-manufacture, and commerce have been considered.

Consumption of food, though as yet less under the direction of science than the more external activities in connection with food, is in no less need of scientific regulation.

Selection and *preparation* of food determine largely the adjustment of diet to human life.

Nature supplies food; men and women cultivate it; women and men prepare it; humanity needs it and eats it. Human life continues through food nourishment; work is done by food-energy. Strength and health depend upon the food eaten, its kind, combination, quantity, quality.

Eating is a common physical necessity of all living things.

Doing and learning are both needed to produce, choose, prepare the foods human beings require for life, health, strength, growth, work.

Skill and specific scientific knowledge are required for the best production of food to-day. Individual producers therefore no longer attempt to grow everything, but simply what can be well and economically grown together. Only what cannot be thus grown in a locality needs to be brought from afar. It is thus that humanity is healthfully nourished and so occupied as to develop both physically and mentally.

Knowledge and experience concerning wholesomeness in food is a general necessity, especially as factory industry commercially supplies humanity with much of its food. Ability to *select* nutritious food continues an urgent need even when food is prepared outside of the home.

Humanity is increasingly studying its food-needs and how to meet these more adequately, yet less laboriously.

Food serves a human purpose only as it nourishes humanity.

Science studies what is happening to find how living may be made so to interwork with nature as to make life stronger, more wholesome, and human well-being the natural state of humanity.

Food-Science is a study of *Human Foods* and *Human Nutrition* (that is, the way the body uses food), to learn how to promote *Human Nourishment*, hence *Human Health*, through such *Food Habits* as establish *Digestion-Efficiency*.

During early ages of human life, humanity ate what nature provided unaided. Man then simply sought plants and animals for food. Later, as human homes became more settled, food began to be produced by man. He worked with nature to raise near his home the foods the family needed in order to live, grow, work.

Cultivation of foods suited to human needs has increased as humanity has lived on. Preparation of food has also been extended. As humanity has itself become more intelligent, it has begun to study its food and how this nourishes it. Seeking food — producing, preparing, studying it — is teaching humanity what and how it needs to eat for health, strength, length of life. Thus is learned what the need for food is under different conditions, what food is and does, how food should be prepared, and how the body can use it.

Producing and preparing food are everyday, necessary activities. They are world-wide occupations of women and men and have been throughout the civilized life of humanity. The well-being of humanity, its ability to grow, and its power to work, require that good food be produced and be well prepared.

When one does not eat, he feels hungry; he needs food. If hunger continues unsatisfied, there is loss of strength. But after eating, strength returns and one feels like being active again or at work. When food is cooked, it often seems easier to eat, and many foods taste better. But all foods are not more digestible when cooked; eggs, for example, are not. Cooking seems to do something to food. Foods do not all seem alike, but all seem to do something for the human body.

What a food does in the human body to nourish it and what happens when a food is cooked depend upon what the food is.

In general, food is considered animal and vegetable, because it comes from animals and plants. But to know what food does for physical growth, energy, and health requires that one know more about foods than simply that they are animal and vegetable.

It is through study of food that one learns what food does for the body and how it does this; how cooking can aid in doing it; and how different kinds of food help the body differently. Starchy vegetables, such as potatoes, give it energy. What is known about what to eat, how to cook, what food does, needs to be considered together. It is thus one becomes able to choose and prepare foods that will keep a body well, help it to grow, and make it strong and full of energy.

It is customary to eat more than one food at a time and such foods together as taste and seem different, as bread and butter. Such foods have been found to be different and are called by different names, as meats, vegetables, fruits. The combination of foods generally eaten together is called a diet. It is from foods eaten together that the body gets the nourishment it needs for health, energy, and ability to grow.

It is therefore a diet, a food-combination, — foods eaten together, — which supports life and provides energy. The foods eaten together must therefore make a food-combination that will build the body, keep it in good running order, and supply it with energy.

To know what foods should be combined in order to do for the body what food can do, it is necessary to know what each food is and does. The composition of foods and the use of each to the body need therefore to be known in order to know how to combine foods to provide for growth, energy, health.

The human body needs, in order to grow or to be active or to work or even to live, to take in air, food, water, and to dispose of the waste products that accumulate in it.

The activity of the internal organs of the body, such as that of the heart, lungs, etc., is work that the body does. This is usually done without the person's being aware of it; some of it continues during sleep. In the waking-hours the body-activity usually appears to be work. But all its activity, whether evident or not, is work for the body and requires energy.

The body gets its energy to do this *work* from food. As the body is active even in living, it wears out and needs repair. It takes from food the materials that it needs for repair and to keep itself in good running order. If one is growing physically, as all do until the twenty-fifth year, the body gets the materials it needs for *growth* from food. How the body uses food for warmth, work, repair, and growth, physiology tells.

It has been found that some foods that will give the body energy will not provide for its repair and growth; such are fats, sugar, and many vegetables. As the body needs repair every day, it must be clearly known what kind of food or what in food will repair the body-tissues, as activity wears these out; also what kind of food or what in food promotes growth, and whether what is necessary for repair, growth, warmth, and energy is in the foods being eaten.

It has also been found that when such a combination of foods is eaten as will do all that food can for the body, each food in it is more fully used by the body than when eaten alone.

Growth, repair, health, heat, energy, for the human body must come from food. The body needs also air and water; likewise care and regulation of body-activity.

It has been learned through science that the food taken into the human body is broken up by digestive agencies. It is then made over for body-use and body-tissue for repair or growth. Energy is provided by the heat generated as the body-tissue breaks down in working and as the food unites with the oxygen of the air breathed in by the body. In some respects this action is similar to the production of heat as fuel burns. As fuel burns it unites with the oxygen of the air in the stove; heat is thus produced. This heat in the body supplies the body-heat and is converted into the energy that the body uses as it works, as heat in the stove may boil water.

But no machine, it must be remembered, has the power of self-repair through simply the energy fuel gives it. Self-repair and growth come only with life, so the body has in its power of self-repair and growth what all machines lack.

It has also been learned that food and the human body are composed of the same constituents, five in all. Though most foods contain all five constituents in some quantity, all are not present in the same quantity in the same food, nor are the quantities of the different constituents in any food the same as in any other.

It is the chief constituent of a food which gives it its principal use in the diet; but all that is edible in a food is used in the body.

The food constituents that *build and repair* (*protein and mineral salts*) are in largest quantity in eggs, milk, cheese, meats, grains.

Those that give *heat and energy* (*carbohydrates and fats*) are principally in starchy vegetables, sugar, fats, oils.

Those that especially *aid the body* in keeping itself in condition *to use its food* are green vegetables and fruits.

The body is a living organism; it needs to be active as well as supplied with the air, water, food, that will so nourish it as to make effective activity possible to it. Its internal activity must itself be sustained for health and strength of body. Digestion of food is as important to nourishment as is food itself. A body that cannot digest food cannot be nourished; a food that cannot be digested cannot provide sustenance.

It is therefore as important to make and keep a body wholesomely active in all its functions as to supply the food materials it needs. Oversparing a body in health weakens it; in illness such care is often its temporary need. To make a body able to use all usual foods is its health-necessity. To prepare foods so that the body-processes are not utilized in digesting the food tends to incapacitate the digestive tract by non-use. Whatever aids in bringing about the above, necessary conditions aids nutrition; that is, the nourishing of the body by the utilization of food.

Pure air in abundance is imperative for assimilation of food, as it is food combining with oxygen which gives heat-energy and brings food into form for transformation into body-tissue. Deprived of air a body cannot be nourished, no matter what it may be fed. If air is cut off from a candle or lamp, the flame dies down and goes out; if air is cut off from a fire, it dies out; if air is exhausted in a building, as it may be in a fire, people die because they cannot breathe. If the air-supply is limited where people live or work, their food is not digested. Their bodies are harmed in other ways by lack of air. If impure air is breathed, it acts as would deficiency of air, and also causes such diseases as its impurities propagate.

The air-need is 30 cu. ft. per hour per person.

AN ITALIAN WELL-HEAD

No less imperative than an abundance of pure air to digestion of food is plenty of *pure water.* Water and air perform different functions, hence the necessity of both. Their purity is important for all. Water liquefies food and aids in its transformation; air effects the oxidation of food, through which it is made useful to the body.

Besides the water taken in food (see Food-Composition) usually about three pints (or six glasses) of water a day is advised as drinking-water. The habit of drinking water between meals should be formed, for then water does not overdilute digestive juices at the time they are needed to digest the food eaten at meals. Drinking water between meals has the further advantage of bringing it into the digestive tract at the time the food eaten needs to be further liquefied. At night and in the morning ($\frac{1}{2}$ hr. before breakfast) a glass of water further aids nutrition by assisting in the removal of waste products.

Rest no less than activity is essential to health of digestion as it is to health of body. The digestive tract needs an abundant blood-supply when actively digesting food. As extreme physical or mental activity prevents this, there is need to lessen both for at least half an hour after meals, to which one should come not overtired, as exhaustion decreases digestive activity. Sleep does too, hence the inadvisability of sleeping immediately after eating. The digestive tract itself needs a period of rest between those of activity; eating too frequently prevents digestive recuperation. To digest food and to keep itself free from accumulated waste products the digestive tract itself needs health.

Activity alternating with rest, leisure to digest a suitable supply of wholesome food, periodic thorough removal of waste products, secure health of body and digestion of the food the body needs for its life and work.

By custom, humanity has eaten a *mixed diet;* that is, a combination of animal and vegetable food substances. In America three meals a day are usual; in England, four (tea in the afternoon); and in France, two, with coffee and rolls in the morning.

Illness and infancy have needed and secured special diets everywhere civilized life has penetrated. Children are not just little adults. Their bodies are growing not simply larger but are in some respects themselves being formed. Teeth illustrate this. Other body-formation is also going on which is no less important, though not so easily seen as is the coming of teeth. Since food is for the body to use, food for children must be such as the developing body of childhood can use. (See p. 202.)

In recent years, science has learned much through observation and experiment about the effect of food on health and physical development. This was not so fully known in earlier times. The kinds and quantities of food needed to sustain life, to provide energy, to promote development, to maintain health, and to regulate body-activity are now carefully studied. What is known is also being more generally taught, that through such knowledge humanity may have health for wholesome living, strength to work, length of active life.

As results of scientific study, *more thorough mastication* than is usual is urged for all; for all adults not at hard physical labor, *less food;* for all persons in health, a *mixed diet.* It is thus that the digestive tract is used as a whole; it is such use of it that keeps it in health.

Excess of food overworks the human system and overburdens it with waste products. Thus may be caused indolence, restlessness, illness. Lack of thorough mastication prevents full digestion of the food eaten. Health and economy are therefore both promoted by *thorough mastication.*

Though a mixed diet is advised, there is a distinct choice in the desirability of the animal foods eaten. Less red meat is urged; it contains substances (extractives) that are stimulating rather than nourishing. In moderation their stimulation may sometimes be wholesome. In excess it is disadvantageous; it harms, whereas food that nourishes helps the body to grow, to care for its own action, and to do the work the person does. Eggs, milk, and milk-products, as cheese, are animal foods without extractives, as are also white meats, such as poultry and fish.

It is sometimes stated that some nations, and such of all nations as are very limited in their food-supply, live mainly, if not entirely, upon a vegetable diet and secure their building-food material from grains. Science finds this is not the general practice anywhere. Rice in the Orient is supplemented by fish and poultry, the potato of Ireland by bacon, the grain foods of the workers of continental Europe by cheese, the corn-meal of our Southern states by eggs and poultry.

Wherever fresh meat cannot be kept or afforded, animal foods that can be found or raised are everywhere somewhat used. On the seacoast and along streams fish abound and are eaten. Inland game and the products of domestic animals, as milk and eggs, are eaten where the animals themselves would be too costly for food, or for other reason would not be so used.

Grains *thoroughly masticated* after being *thoroughly cooked* build the body. Yet alone they cannot do all that is done by a mixed diet. To the young it brings foods prepared by nature for animal young, as are milk and eggs. While children are themselves being formed and learning to eat adult-diet, they need such nature-prepared building food. Mixed diet also makes, for all, body-tissues that retain elasticity in advanced age. Such tissue not only lasts long but is capable of prolonged activity.

What one is used to eating often seems satisfying, even when it is not a satisfactory diet and is not doing for the body what only food in the combination needed can do. Food habits are formed as one eats and lives; they largely control the choice of food. This strength of habits should be used to aid the body, by making the diet needed by the person the usual familiar diet. The kind of food-combination that science has learned will give physical endurance and energy, will build and repair the body and assist it in using its food, is the necessity of every one and can be known by all. For children to form such a habit as that of tea- and coffee-drinking is to rob them of the opportunity of having well-nourished bodies.

Physical construction of the body, power of self-repair, living-energy in life-activity, all depend upon the food-regulation of the person; hence the importance of food habits, food tastes, and food practices. If the food eaten is not able to do these things, they are not done or only partly done. The body that is poorly nourished may live and do some work, but it is without resistance to disease, if not itself diseased. It is less strong as it is less well, also less effective in whatever it does.

If the food eaten is not used by the body, because the food chosen does not meet the need there is for food, the food is not only wasted but overburdens the body with food-waste; this hinders its action and if unremoved poisons it. Though building, energy, digestion foods can, as stated above, be found in either the animal foods or in vegetable, were they exclusively taken from either, the body would be overworked. Less work is required to use food from both together, because each food then digests more easily and fully, and the digestive tract in being thus used as a whole works better itself than when only part of it is used.

Food habits, like all habits, save work when they are such as help, and make work when they are such as hinder. They may nourish or they may prevent nutrition. As the body must not be habitually overburdened with food or overworked by it, so it must not be undersupplied or underexercised in using food.

In excessive meat diet extractives overstimulate the body; in excessive vegetable diet vegetable fiber overirritates the digestive tract. Excess of building food overworks the kidneys; excess of energy food overweights the body with fat that may make it idle instead of active.

A diet of food deficient in the food-constituents needed leaves the body undernourished. This happens no matter how much food is eaten, if it is not of the kinds that together make the food-combination needed. An undernourished body is without energy or health; hence the importance to human life of knowing and using in living what science has learned about:

(1) Which food-constituents different foods contain.

(2) How much of the different food-constituents is present in a given amount (as 1 lb.) of any food.

(3) What amounts of each food-constituent the body needs in a given time, as a day or week.

Two of the five food-constituents (protein, carbohydrate, fat, mineral salts, water) do not need constant consideration if a mixed diet of wholesome natural food is eaten; these constituents are mineral salts and water. A mixed diet gives the mineral salts needed in health. When an excess of mineral salts is needed, as in growth and some types of illness (as bone-deterioration, such as rickets in children), milk and eggs should be eaten in larger quantities; these provide the additional salts then required. Water is needed by the body in relatively large quantity. It is also present in most foods in large proportion.

When one is growing, food that will build physically is especially needed and should be eaten. All body-activity, even simply living, wears the body out so that it needs repair ; that is, rebuilding of its tissues.

The body contains more water than any other constituent. Water keeps the liquids of the body, as blood, in a fluid state. The next largest quantity of a body-constituent is mineral salts ; the body-skeleton is mainly mineral matter. Protein, the tissue-substance, is next in quantity ; it forms tissue, as body-muscle. Body-fat is next. Carbohydrate is least and in very small quantity in the body.

It is *strength of body* which tissue-building food (protein) promotes. It forms the body during growth ; it repairs for tissue-activity as one lives and works. Beef and mutton build, repair, spare tissue, and stimulate. Chicken and oysters do not stimulate. Eggs, milk, cheese, build, repair, and give energy, as do cereals, breads, graham crackers, macaroni. Beans, peas, lentils, build, repair, and give energy. Most foods do this somewhat. *Mineral matter* builds bone and aids growth and body-activity too.

Science finds the overeating of meat one of the mistakes of human diet. Red meats through their extractives may so stimulate as to leave a body feeling alive but neither strong for work nor able to sustain activity. A body so fed may tire quickly after eating ; it may feel hungry soon. Constant need of food may keep a body so occupied digesting food that it is able to do little else. The digestive tract may be worn out by such overuse.

Even the tissue-formers without extractives (eggs, milk, white meats, grains), if overeaten, require the body to dispose of body-waste and food-waste that need not have troubled it, do exhaust it, and may poison it, instead of repairing it for wholesome working.

For the quantity of tissue-forming food needed, see p. 222.

One that feels full of life and is active has energy. The work of the body is done by its energy. Even a well-formed strong body could not work long if food brought no energy-supply. The body would use itself for the energy required in living. Hence the need of heat-energy foods for body-heat and activity, and building foods for tissue-growth and repair. It is thus that the body is aided by food in its living and working and not hindered by unnecessary waste or work.

Energy foods form the largest proportion of daily food, but enter into the body-composition in the least, for they are consumed for current body-heat and activity.

It is *activity of body* which energy foods (carbohydrates and fats) promote. These provide for the active living of the body itself and its action in the work one does.

Starch, as in starchy vegetables (potato, rice), grains — carbohydrates.
Sugar, as in sugar mixtures (cake, candy), fruits (dates) — carbohydrates.
Fat (and oil), as in meats, butter, cream, olive and other edible oils — fats.

Starch requires prolonged cooking and longer digestion than sugar or fat. The delayed digestion of starchy food enables it to provide energy longer after eating than sugar and fat energy foods. Starchy food gives endurance in activity. But were it only used for energy, the supply of energy would be too delayed and the digestive tract overworked in securing from starch alone all energy needed. It might also be overburdened with vegetable fiber, with which starch is usually combined in foods.

Sugar and fat are therefore also necessary heat-energy foods. But used alone they would require too continuous eating to sustain energy, because used so quickly. They are not usually as digestible when constantly eaten in appreciable quantities as is the starch in potato and bread. Sugar and starch may store fat in the body. Fat in food probably does not.

Though it is eating animal and vegetable foods together that furthers digestion of all food eaten, there are some foods that seem especially to promote digestion. Such, rather than direct nourishment of the body, is the principal use in the diet of many fruits and green vegetables. These foods contain water in large quantity and mineral salts in large proportion to all their solid constituents. They give a sense of freshness and well-being by enabling the body to do all its work well through being kept in good running order. Mineral salts and water are needed in growth, also throughout life for regulating the body-action within the body itself.

Green vegetables and fruits usually also contain vegetable fiber (cellulose) in relatively large quantity. This is practically indigestible. Its presence tends, however, to increase the peristaltic action in the intestine. This aids in freeing the alimentary tract of food-waste products. When these are not removed, they encourage germ-life, that may disorder digestion, even when no specific disease, such as typhoid fever, is caused by the presence of disease-germs.

Nature has produced some foods that, when properly used, help the body to work without itself being overworked by digesting the food that life and work require.

Laxative foods are such. They especially aid the body in keeping itself free from food-waste. Such foods should be used instead of medicines for this purpose. These are :

Tomatoes, onions, spinach, rhubarb, green vegetables in general.
Apples, peaches (ripe), orange- and grape-juice, prunes, dates, figs.
Cereals, mush, bread (rye, graham, whole-wheat), gingerbread.
Olive-oil at night. Water at night and in morning ½ hr. before breakfast.

Whatever diet will do for the body is more wholesomely done thus than in any other way.

What the body can do itself in utilizing its food, it needs to do in health. But digesting food is not the only activity of the body. Important as digestion is, it needs to be so accomplished that the body is prepared through it for other work and not simply absorbed in its own living. Though all *unnecessary* digestion impairs body usefulness, if not health itself, wholesome digestive activity is essential to healthful digestion.

Fat in moderation aids the general working of the body; without it disorders and difficulties ensue. For the same weight fat furnishes over twice the quantity of heat-energy which sugar or starch can produce. Active children and physically laboring adults can use more fat than others use fully or digest freely. Fat passes as heat-energy and is probably not stored as body-fat. Sugar and starch eaten beyond the immediate need of the body become body-fat. Body-fat protects other body-tissue from use for energy by itself furnishing heat and energy first. Fat-reserve serves thus in illness and food-deprivation of any type. Excess fat in the body or in food usually interferes with health.

Tissue-sparing is a function of some protein foods. Gelatin (p. 94) is a form of protein which will not build tissue, but by being present in the diet can prevent body-tissue from being worn out by work. This has a use even in health, as the unnecessary breaking down and renewal of tissue consumes energy. All needless body-functioning destroys instead of preserves wholesome body-activity and the body itself in a state of healthful repair. In illness tissue-sparers are often necessary. They save a body weakened by disease from the drain upon it that would otherwise be required to sustain the work of repair beyond the repair-need absolutely imperative to preserve life.

In the processes of nature there goes on all the time a breaking down of complex substances into simpler and a building up of simple substances into more complex. Bacteria break down complex substances; plants and animals utilize these. Human bodies take for food the more complex substances prepared in plants and animals. Waste products of body-activity are complex; bacteria break these down and return simpler forms to the soil and atmosphere for nature's further use.

Though human foods have concentrated in them many chemically complex substances, study of food-composition has shown that all foods are not equally complex or condensed. Some are principally water; the solid nutrients in these may be relatively small. Other foods show condensed solid nutrient substances, as do grains, but without all of these always being fully available as digestible human food. Still others contain very little that is not nutritive, and in a form to be fully assimilated by the body. (See eggs, p. 108.) Such are nature's concentrated foods.

Such foods are of great value, but they cannot be used exclusively. As the body is and now works it needs some bulk to its food for its digestive tract to function. In the variety in which nature makes food available much that is found in food that is not itself nourishing may aid the body in utilizing food, as does water. It is, however, important in what quantity even natural constituents in food, as cellulose, be eaten, if not themselves nutrients, that is, nourishing substances. Though such non-nutrients may aid digestion somewhat, they do not supply the material that makes either the body or its energy.

Concentrated foods of nature, though they contain in themselves all food-constituents that nourish and are free from the dangers of condensed foods of commerce, are not all-sufficient as human diet, exceedingly important factors as they are in it.

Feeding the body food it cannot use can starve it. Preparing food so that it does not require activity of the entire digestive tract may incapacitate the body. Human food needs to be in wholesome condition, properly chosen and prepared, and the body itself be so cared for that it is well and works well in its living-processes. It is thus that the body is nourished.

Predigested foods are usually prepared with a ferment that does part of the work of the digestive juices. Such a food uses the alimentary tract only partially, whereas it needs to be fully active to be well itself. In illness, predigested foods are sometimes needed. Peptonized foods serve to nourish a body that cannot otherwise nourish itself. Fermented foods, as koumiss, may save the body similarly when this is its need.

Prepared foods may by factory preparation of food materials lessen home work. Cereals are commercially so prepared. They keep less well when partially cooked and are more expensive. They take up water as cooked, and do not then resist further changes that they would in the dry state. The moisture absorbed increases the weight. Such preparation saves work in the home, and home fuel for prolonged cooking. There is, however, in all such commercial food-preparation the danger that the home completion of the process may be insufficient. This often happens with cereals and results in such prepared foods being used underprepared. Other prepared foods may lose water; all condensed- and powdered-milk preparations do. The high heating of milk changes its composition.

All canned, preserved, dried, steamed, or otherwise cooked foods are prepared for keeping or for digestion. Any aid that makes a food digestible is desirable, but any effort to digest it externally may prove a deprivation by making unnecessary the body-activity that is essential to healthful digestive functioning.

Kinds and amounts of food are both important to health. They act together in securing health. Both must change somewhat under different conditions of life if food is to aid a body in living and working effectively. The life of the body itself requires food; the work of the body does, too. The age of the person, the size, sex, health; the work; the climate, season, — all affect both the kinds and amounts of food needed. The location and circumstances affect the food-supply of families.

Amounts and kinds of food must not only provide adequately for the body-needs but must supply foods that can be used under the conditions prevailing. A child is learning to eat; an adult is using food to work; the aged are losing the ability to use food. The food-need of the adult of very active physical life differs from that needed for less muscular exertion, mainly in the energy-supply necessary. For much manual work much heat-energy is needed; for a life of little physical activity more digestion food-aid is required; for age and childhood easily digested food is essential. But the power to digest food is going from the aged and coming to the child. The aged are becoming increasingly inactive, with tissues that are worn, not developing as are a child's. The aged have decreased need for energy food for work, but somewhat increased need for body-heat and body-repair.

Building foods, heat-energy, and digestion foods are all needed always. Which foods are preferable under different conditions, and why they are, has been discussed. Because most foods contain some of all constituents that build, give energy, and aid digestion, a very limited food-supply will keep alive those restricted to it. But for vigor and health the food-supply needs to be plentiful, varied, wholesome, and the diet selected in accord with the food-needs of those it feeds.

In health the same person under the same conditions of living needs the same food-constituents and in the same quantity, but needs to obtain these from a variety of foods. Starchy vegetables are of many kinds, as are also green; so are fruits, grains, dairy-products, and animal foods. Though no two foods are exactly alike, a class of foods serves in general the same food-purpose. How foods differ from one another and how the classes of foods differ is shown on pp. 190–193.

Adults can usually digest all kinds of food and all the foods of each kind. That they may be able to do so it is, however, necessary that as they mature they learn to eat every common food. For diet-restrictions in childhood, see pp. 202–205.

The kinds of food a family has eaten, it usually prefers. The kinds that have prevailed in a locality are usually preferred there. Sometimes an earlier need for a kind of diet passes, but leaves that diet as the food habit of the district. It is often found that where it was originally hard to grow or get food a greater variety is not desired even when it becomes possible. Often new foods cannot be easily introduced even when they are desirable and obtainable; this is most frequent where for a long time few foods have been eaten.

Where much physical activity, especially in the open air, has been usual, as in pioneer times or in agricultural districts, an energy-giving diet containing much starch, sugar, and fat is needed. If the conditions of life change and the food habits are not adjusted to the change, the former diet may cause illness. The breakfast of colonial days in New England would menace the health of any one not doing hard work out-of-doors. The need to change diet increases with travel and variation in occupation; the ability to do so comes with the habit of eating many kinds of food.

As seasons change, foods do too, in availability and quality. The food-needs of the body are also altered by temperature changes, as they are by change from one climate to another.

When it is cold, heat-giving food needs to be increased, because the body then loses heat more rapidly; it is also usually more active in cold weather. In warm, more liquid and refreshing food is needed, and from ¼ to ½ less food than in winter.

At all times repair food is required. The quantity needed is small (¼ lb. or less daily per adult person). This varies less for the same person or for persons of like maturity than do other food-needs; during growth this is increased and varies more. As growth is periodic even during the years it continues, the food-need it occasions varies with seasonal growth itself.

Foods that keep well form the staple food-supply of winter. Foods as they grow offer the variety desirable in summer. The fall brings uneven weather and with it danger of disease; this needs to be met with a substantial regularly sustained food-supply that can reënforce physical resistance and thus maintain health. Spring often saps vitality. Food then needs to be palatable and plentiful; it must invigorate, even though the desire for food may be so decreased as not to seek adequate sustenance for the body.

Fruits and green vegetables are desirable at all seasons but necessary in warmer weather. Thin soups and light, cold desserts aid in making food appetizing in summer. Starchy foods (as heat-producing flour mixtures), cereals, sugars, fatter meats, thicker, richer soups, supply satisfactorily the food supplement winter requires. In warm weather breakfast should be early and the evening meal after the heat of the day subsides, for food to be refreshing. More water is needed in summer before retiring, upon rising, and between meals.

In the morning the body is rested through sleep; at night it is tired; during the day it is at work. In getting ready to work in the morning it needs an energy-supply that is not so heavy as to burden the body with food-care instead of providing it with food-help. Food that will somewhat spare tissue, and digestion-foods, are also morning food-needs.

For those not at hard physical work the noon food-need is for some sustaining energy food that will be easily digested, though not entirely used over-quickly; also slight building and refreshing food. At night the adult body needs repair, some energy food that will be readily digested; also some laxative food, but no highly stimulating food. For children's needs, see pp. 202–205.

It is usual to consider $\frac{1}{2}$ the daily food the dinner-amount and $\frac{1}{4}$ each the breakfast and luncheon. Meat is advised not more than once a day. Red meat (beef, etc.) should alternate with white (chicken, etc.) or other non-stimulating animal food (eggs, etc.). At noon vegetable building food is suitable, for then the starch combined with it has an opportunity to digest before sleep and furnish sustaining energy for the latter part of the waking day. As $\frac{1}{2}$ the building food should be animal and $\frac{1}{2}$ vegetable, this gives an opportunity to arrange it so.

The quantities of food desirable and the differences in child- and adult-diet will be considered later. It is said a man at hard work and a child over 2 years cannot be overfed; that *food enough* is their need. But the child is to be built much for growth and needs much energy for exercise, as growth depends upon exercise too. The child is, however, only learning to eat. The man has learned and is grown. He needs great energy and much repair — energy-food that lasts and food that spares as well as repairs tissue. Therefore though a child of 2 years and over and a laborer both need much food, yet they need different food (pp. 189–203).

More food is needed in cold weather than warm; more by those of large stature than small; more by men than women; more by adults than children; more by adults in full vigor than the aged; more by those that do hard manual labor than those that do moderate manual work; more by those that do moderate manual work than those that do sedentary or desk work.

Amounts of food needed under different conditions compared with that required by a man at moderate muscular work.

	Hard Labor	Moderate Work	Sedentary Activity
Man	$1\frac{1}{5}$	1	$\frac{4}{5}$
Woman	1	$\frac{4}{5}$	$\frac{7}{10}$
Old age, $\frac{9}{10}$ — Extreme old age, $\frac{7}{10}$–$\frac{4}{5}$			
	15–16 Years	13–14 Years	12 Years
Boys	$\frac{9}{10}$	$\frac{4}{5}$	$\frac{7}{10}$
Girls	$\frac{4}{5}$	$\frac{7}{10}$	$\frac{3}{5}$
	10–11 Years	6–9 Years	2–5 Years
Child	$\frac{3}{5}$	$\frac{1}{2}$	$\frac{2}{5}$
Infant under 2 years, — $\frac{3}{10}$			

(Write the above proportions as decimals) Food-quantities in Daily-Diet, p. 222

The amounts of food needed by a man at different work decrease by $\frac{1}{5}$; by a boy at different ages increase by $\frac{1}{10}$.

How do these change for women, girls, children, the aged?

Not simply the total quantities of food needed by adults and children differ, but also the amounts of the different food-constituents. (See p. 203.)

For kinds and amounts of food suitable for children at different ages, see pp. 202–203.

What occupations are heavy manual labor in city and country? Which are moderate? Which light or sedentary?

Compare amount of food for a man at sedentary work, a woman at moderate labor, boy 13–14, girl 15–16, and extreme old age.

Under what conditions will any one else need what a boy 15–16 eats? Under what conditions will a woman, boy, and girl need what an aged person eats?

How much food does a boy need at 12? a girl at 12? a boy at 10? a girl at 10?

When do boys and girls need the same amount; when different?

When does a child need $\frac{1}{2}$ as much food as its mother? as its father?

How much more food does a boy 13–14 need than a child 2–5?

Distribution of Incomes	\$1000	\$2200	\$3600
Food	$\frac{1}{3}$	$\frac{5}{16}$	$\frac{5}{18}$
Rent	$\frac{1}{6}$ +	$\frac{1}{6}$ +	$\frac{1}{6}$ +
Maintenance of house	$\frac{1}{6}$	$\frac{3}{16}$	$\frac{1}{6}$
Clothing	$\frac{1}{6}$ –	$\frac{1}{6}$ –	$\frac{1}{6}$ –
All other expenses	$\frac{1}{6}$ –	$\frac{1}{6}$ –	$\frac{2}{9}$

(Write the above proportions as decimals) (For families of 5: 2 adults; 3 children)

How much in dollars does each family spend for food? for rent, etc.? for food a week? Compare food expenditure with that given on page 156.

If the man at \$1000 does heavy labor, and the one at \$3600 sedentary work, how much more food would the former need? If one mother does moderate work and the other light, what is the difference in the food-need?

Will a family of girls or boys spend more on food?

If each of the above families had a boy over 14, a girl under 12, a child of 8, and the father and mother do moderate work, what would each spend apiece for food a week?

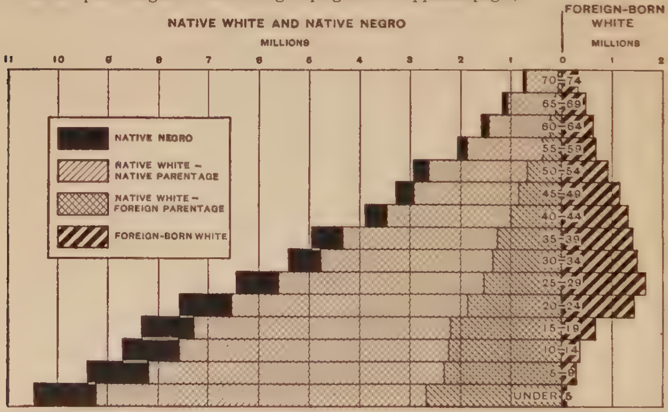
Try this with other families that you select yourselves.

CENSUS, 1910	TOTAL	%	MEN—BOYS	RATIO	WOMEN—GIRLS
Total Population	91,972,266	100.	47,332,277	106. to 100	44,639,989
Under 5 yr.	10,631,364	11.6	5,380,596	102.5 " 100	5,250,768
5 to 14 "	18,867,772	20.5	9,525,876	102. " 100	9,341,896
15 " 24 "	18,120,587	19.7	9,107,572	101. " 100	9,013,015
25 " 44 "	26,809,875	29.1	14,054,482	110.2 " 100	12,755,393
45 " 64 "	13,424,089	14.6	7,163,532	114.4 " 100	6,260,757
65 and over	3,949,524	4.3	1,985,976	101.1 " 100	1,963,548

% DISTRIBUTION BY AGES OF MEN — BOYS AND WOMEN — GIRLS

	UNDER 5 YR.	5 TO 14 YR.	15 TO 24 YR.	25 TO 44 YR.	45 TO 64 YR.	65 AND OVER
Men—Boys	11.4	20.1	19.2	29.7	15.1	4.2
Women—Girls	11.8	20.9	20.2	28.6	14.	4.4

(Find similar percentages for different groups given on opposite page.)



(From the Thirteenth Census of the United States, 1910)

Compare percentages in diagram for 1910 with number of persons stated on opposite page.

Make a comparative chart of these percentages in both diagrams. Use heavy, solid black for 1910 and crossed lines for 1900.

Census, 1910	Total	%	Men—Boys	Ratio	Women—Girls
Native white (native parentage)	**49,488,575**	**100**	**25,229,218**	**104 to 100**	**24,259,357**
Under 5 yr.	6,546,282	13.2	3,326,237	103.3 " 100	3,220,045
5 to 14 "	11,185,298	22.6	5,669,886	102.8 " 100	5,515,412
15 " 24 "	9,771,977	20.1	4,885,442	100. " 100	4,886,535
25 " 44 "	12,946,441	26.1	6,642,210	105.4 " 100	6,304,231
45 " 64 "	6,740,000	13.6	3,547,325	111.1 " 100	3,192,675
65 and over	2,201,068	4.4	1,089,349	98. " 100	1,111,719
Native white (foreign or mixed parentage)	**18,897,837**	**100**	**9,425,239**	**99.5 to 100**	**9,472,598**
Under 5 yr.	2,674,125	14.2	1,350,473	102. " 100	1,323,652
5 to 14 "	4,551,444	24.1	2,289,629	101.2 " 100	2,261,815
15 " 24 "	4,078,683	21.6	2,008,982	97.1 " 100	2,068,701
25 " 44 "	5,210,109	27.6	2,644,475	97. " 100	2,644,475
45 " 64 "	2,117,386	11.2	1,076,222	103.4 " 100	1,041,164
65 and over	255,586	1.4	128,662	101.4 " 100	126,924
Foreign-born white	**13,345,545**	**100**	**7,523,788**	**129.2 to 100**	**5,821,757**
Under 5 yr.	102,507	.8	51,940	102.7 " 100	50,567
5 to 14 "	656,839	4.9	331,955	102.2 " 100	324,884
15 " 24 "	2,104,142	15.8	1,175,674	126.6 " 100	928,468
25 " 44 "	5,879,979	41.9	3,442,770	141.3 " 100	1,497,783
65 and over	1,183,349	8.9	607,008	105.3 " 100	576,341
Negro	**9,827,763**	**100**	**4,885,881**	**98.9 to 100**	**4,941,882**
Under 5 yr.	1,263,288	12.9	629,320	99.3 " 100	633,968
5 to 14 "	2,401,819	24.4	1,197,249	99.4 " 100	1,204,570
15 " 24 "	2,091,211	21.3	990,102	89.9 " 100	1,101,109
25 " 44 "	2,638,178	26.8	1,304,098	97.8 " 100	1,334,080
45 " 64 "	1,108,103	11.3	595,554	116.2 " 100	512,549
65 and over	294,124	3.	152,482	107.7 " 100	141,642
Indian	**265,683**	**100**	**135,133**	**103.5 to 100**	**130,550**
Under 5 yr.	40,384	15.2	20,202	100.1 " 100	20,182
5 to 14 "	67,934	25.6	34,548	103.5 " 100	33,386
15 " 24 "	50,330	18.9	25,877	105.8 " 100	24,453
25 " 44 "	60,175	22.6	30,840	105.1 " 100	29,335
45 " 64 "	32,925	12.4	17,055	107.5 " 100	15,870
65 and over	12,986	4.9	6,130	89.4 " 100	6,856
Chinese, Japanese, and all others	**146,863**	**100**	**133,018**	**960.8 to 100**	**13,845**
Under 5 yr.	4,778	3.3	2,424	103. " 100	2,354
5 to 14 "	4,438	3.	2,609	142.6 " 100	1,829
15 " 24 "	24,244	16.5	21,495	781.9 " 100	2,749
25 " 44 "	74,993	51.1	68,930	1,136.9 " 100	6,063
45 " 64 "	33,157	22.6	32,441	4,530.9 " 100	716
65 and over	2,411	1.6	2,345	Women less than 100	66

ANIMAL FOODS

(From the Thirteenth Census of the United States, 1910)

	SOLD	VALUE	RATIO OF SALES TO PRODUCTION		PRICE IN 1909
			(1909)	(1899)	
Milk (gallons)	1,937,255,864	$252,436.757			13¢ per gal.
Cream "	54.933.583	37,655,047			68.5¢ " "
Butter fat (pounds)	305,662,587	82,311,511	%	%	
Butter "	415,080,489	100,378,123	41.7	48.3	25¢ per lb.
Cheese "	8,136,901	987,974	86.5	89.7	14¢. " "

	PRODUCED	SOLD	VALUE	% INCREASE 1899–1909	
				(quantity)	(cost)
Eggs (doz.)	1,591,311,371	926,465,787	$180,768,249	23%	112.6
All fowls	488,468,354	153,600,169	75,273,524		48.

ALL DOMESTIC ANIMALS, IN 1909, $5,296.421.619 (TOTAL VALUE)

	NUMBER	VALUE	AV. PER HEAD	ON FARMS	NOT ON FARMS
Cattle	63,682,648	$1,560,339,868	$24.50	$24.26	$32.37
Sheep	52,838,748	234,664,528	4.44	4.44	4.66
Goats	3,029,795	6,542,172	2.16	2.12	3.19
Swine	59,473,636	409,414,568	6.88	6.86	7.82

STATES LEADING IN NUMBER OF ANIMALS ON FARMS, 1910

	ALL CATTLE	DAIRY COWS	SWINE	SHEEP AND GOATS
1	Texas	New York	Iowa	Wyoming
2	Iowa	Wisconsin	Illinois	Montana
3	Kansas	Iowa	Missouri	Ohio
4	Nebraska	Minnesota	Indiana	New Mexico
5	Wisconsin	Illinois	Nebraska	Idaho
6	Missouri	Texas	Ohio	Texas
7	Illinois	Pennsylvania	Kansas	Oregon
8	New York	Ohio	Texas	California
9	Minnesota	Missouri	Oklahoma	Michigan
10	California	Michigan	Wisconsin	Missouri

Are these the states indicated on the maps on pp. 122–125? Which state ranks highest in several products? What are the products? What articles besides food will be produced in the states raising animals?

AND VALUE IN UNITED STATES — 1909 PRODUCTION OF FOOD

(From the Thirteenth Census of the United States, 1910) VEGETABLE FOODS

	PRODUCED	VALUE	% INCREASE 1899–1909		PRICE IN 1909
			Amount	*Value*	
Cereals					
Corn (bu.)	2,552,189,630	$1,438,553,919	73.7	81.5	56¢ per bu.
Wheat "	683,379,259	657,656,801	77.8	71.3	96¢ " "
Buckwheat "	14,849,332	9,330,592	62.3	22.8	62 + ¢ " "
Barley "	173,344,212	92,458,571	122.1	53.3	53¢ " "
Rye "	29,520,457	20,421,812	66.2	43.9	69¢ " "
Rice (rough) "	21,838,580	16,019,607	153.1	4.3	73¢ " "
Vegetables					
Potatoes "	389,194,965	166,423,910	69.2	18.8	43 – ¢ " "
Sweet "	59,232,070	35,429,176	78.3	28.	60 – ¢ " "
Beans "	11,251,160	21,771,482	185.2	1.93	28¢ " "
Peas "	7,129,294	10,963,739	38.6	1.53	83 + ¢ " "
All other "	———	216,257,068	79.8	———	———
Sugar (tons)	11,820,379	61,648,942	89.1	.57	$5.61 per ton
Berries (qt.)	426,565,863	29,974,481	19.8	30.	7¢ " qt.
Fruits					
Orchard (bu.)	216,083,695	140,867,347	68.2	65.3	65¢ " bu.
Tropical, etc. "	———	8,227,838	200.3	———	———
Nuts (lb.)	62,328,010	1,949,931	128.1	46.5	7¢ " qt.
Peanuts "	19,415,816	18,271,929	151.3	.9	55 – ¢ " bu.
Cottonseed (tons)	5,324,634	121,076,984	157.9	34.2	$22.73 " ton

Total crops increased from *1899* to *1909* in value *66.6%*.

Note which crops have increased. Where are they grown? (See maps, pp. 18–19.)

Note prices of large-quantity sales. Compare these prices with current local retail prices.

Estimate for winter wheat crop in the United States for 1914 is 551,000,000 bushels or 11.5% more than average for 10 years past. During this period 36,506,000 acres under wheat cultivation were abandoned.

All information necessary for a complete, exact computation of food consumed in the United States is not available.

For importations of food, see p. 158.

French consumption of food has been calculated. (See p. 159.)

Foods are composed of a great many chemical elements, as *nitrogen*, *carbon*, *hydrogen*, *oxygen*, *sulphur*, *phosphorus*, *calcium*, *sodium*, *potassium*. These so unite as to form the very complex food-constituents, *protein*, *carbohydrates*, *fats*, and the simpler *mineral salts* and *water*.

As it is through the oxidation of food that it comes into use in the body, the fuel value — that is, the amount of heat produced as the food is oxidized — has been determined for all common foods. The amount of heat that foods yield as they unite with oxygen is measured in heat units called calories. A calorie is the quantity of heat which will raise 1 pint of water 4° F (or 1 liter 1° C). Calculation of fuel value, p. 223.

Adults need from their food 2000 – to 3000 + calories a day according to their age, sex, size, work (see p. 223). A man at very hard work needs food that will yield heat enough daily to raise $\frac{1}{7}$ bbl. of water from freezing to boiling, or heat enough in a week to convert 1 bbl. (63 gal.) from ice to steam.

FUEL VALUE COMMON FOODS

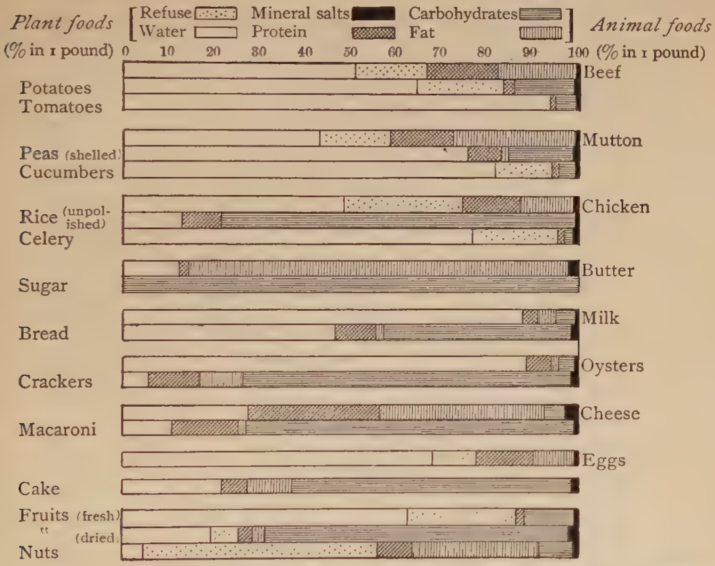
DAILY AMOUNT	AVERAGE IN POUNDS	ONE POUND	FOOD	CALORIES	RELATIVE HEAT VALUE
6–14 oz.	$\frac{1}{2}$	1 loaf	Bread	1200	
2–5 "	$\frac{1}{8}$	40 balls	Butter	3410	
2–5 "	$\frac{1}{5}$	2 C	Sugar	1750	
1–4 "	$\frac{1}{8}$		Oatmeal	1800	
8–16 "	$\frac{3}{4}$	1 pint	Milk	310	
8–32 "	$\frac{1}{2}$	8–10	Eggs	635	
4–12 "	$\frac{1}{3}$		Meat	1045	
8–16 "	$\frac{3}{4}$	3–4	Potatoes	295	
	$\frac{1}{8}$	3–4	Tomatoes	95	
		2–3	Apples	190	
		2–3	Bananas	260	
			Peanuts	1775	

An inactive person weighing 150 pounds needs daily 1800 + calories to *repair tissues*, *supply energy*, *maintain body temperature*.

Foods, the edible parts of plants and animals, are composed of what these are. It is this that makes food capable of carrying into the body substances that sustain its life and activity. These substances (*protein*, *fat*, *carbohydrates*, *mineral salts*, *water*) are present in different quantities. This makes some foods able to take the place of others and some to add in combination what others lack.

FOOD CHARTS

SUPPLEMENTARY FOODS



This comparison is of 1 lb. of each food, but foods, it should be remembered, are eaten in different quantities. This is somewhat controlled by their bulk when prepared. Potatoes 1½–2 lb. is approximately the equivalent of ½–¾ lb. rice as vegetable served with meat. Note their nutrients. Beef 1–1¼ lb. serves three. Butter for three for a day weighs ⅜ lb.

Diet Chart, p. 222 *Calculation of Dietary*, p. 223

R	*W*	ANIMAL FOODS	*P*	*F*	*CH*	*MM*	CALORIES
%	%	***Beef, fresh***	%	%	%	%	*Per pound*
13	52	Porterhouse	19	18		.8	1100
	64	Rib rolls	19	17		.9	1055
7	61	Round	19	13		1.	890
10	54	Flank	17	19		.7	1105
13	54	Sirloin steak	17	16		.9	975
16	57	Shoulder clod	16	10		.9	715
13	53	Loin	16	18		.9	1025
16	53	Chuck ribs	16	15		.8	910
28	46	Neck	15	12		.7	1165
21	44	Ribs	14	21		.7	1135
21	45	Rump	14	20		.7	1090
37	43	Shank (fore)	13	7		.6	545
19	49	Fore quarter	15 –	18		.7	995
16	50	Hind quarter	15 +	19		.7	1045
		Canned, dried, etc.					
5	54	Dried (salted)	26 +	7		9.	790
	52	Canned (corned)	26 +	19		4.	1270
	52	" (boiled)	26 –	23		1.+	1470
8	49	Corned	14 +	24		5.–	1245
6	59	Tongue (pickled)	12 –	19		4.	1010
		Veal					
3	68	Leg cutlets	20	8		1.	695
14	60	Leg	16 –	8		.9	625
21	52	Breast	15 +	11		.8	745
		Mutton					
18	51	Leg (hind)	15	15 –		.8	890
16	42	Loin chops	14 –	28		.7	1415
10	39	Flank	14 –	37		.6	1770
		Lamb					
17	53	Leg (hind)	16	14		.9	860
19	46	Breast	15	19		.8	1075
		Poultry					
23	42	Turkey	16	18		.8	1060
18	39	Goose	13	30		.7	1475
26	47	Fowls	14 –	12		.7	765
42	44	Broilers	13 –	1 +		.7	305
11	66	Eggs	13	9 +		.9	635

R, refuse; *W*, water; *P*, protein; *F*, fat; *CH*, carbohydrates; *M.M.* mineral salts. (Over .5 is considered 1; under .5 is dropped except for mineral salts; + means more; –, less)

What constituent gives animal foods high fuel value? For what are those of low heat value eaten?

CALORIES	*MM*	*CH*	*F*	*P*	ANIMAL FOODS	*W*	*R*
Per pound	%	%	%	%	***Pork, fresh***	%	%
895	1.		13	19	Tenderloin	67	
1320	.8		26	14−	Ham	48	11
1245	.8		24	13+	Loin chops	42	20
1450	.7		30	12	Shoulder	50	12
					Salted, smoked		
1635	4.		33	14	Ham (smoked)	35	14
1335	6.		27	13	Shoulder (smoked)	37	18
2715	4.		62	9	Bacon (smoked)	17	8
3555	4.−		86	2−	Salt pork	8	
					Sausage		
1155	3.+	1	19	20	Frankfort	57	
1155	4.		20	18	Bologna	55	3
2075	2.	1	44	13	Pork	40	
					Soups		
365	1.	6	4	5	Meat stew	85	
120	1.	1		4	Beef	93	
					Fish		
475	.9		4	15	Halibut	62	18
275	.9		1−	13	Perch (dressed)	51	35
220	.8			11	Cod (dressed)	59	30
325	19.			16	Cod (salt)	40	30
370	.7		4	10	Mackerel	40	45
380	.7		5	9	Shad (whole)	35	50
600	2.	3−	4	21	Shad (roe)	71	
755	7.		9	21	Herrings (smoked)	19	44
915	3.		12	22	Salmon (canned)	64	
950	5.		12	24	Sardines (canned)	54	5
340	2.+	5	1	11−	Clams	81	
200	2.−	1−	1−	8	Crabs	37	52
145	.8		1−	6	Lobsters	31	62
225	1.	3	1	6	Oyster solids	88	
					Dairy products		
3410	3.		85	1	Butter	11	
865	.5	5−	19	3−	Cream	74	
310	.7	5	4	3	Milk (whole)	87	
165	.7	5		3+	Skim milk	91	
160	.7	5−	1−	3	Butter milk	91	
1430	2.	54	8	9−	Condensed milk	30	
2075	4.	4	37	28	Cheddar cheese	27	
1885	4.−	2+	34	26	Cream cheese	34	

(Rearranged from *Farmer's Bulletin, No. 142,* United States Department of Agriculture)

Which animal foods contain carbohydrates? In dairy products and fish they are forms of sugar.

R	*W*	VEGETABLE FOODS	*P*	*F*	*CH*	*MM*	CALORIES
%	%	*Cereals*	%	%	%	%	*Per pound*
	10	Wheat	12	2 –	75	1.3	1680
	14	Buckwheat	6	1	78	.9	1605
	13	Rye	7	1 –	79	.7	1620
	13–	Cornmeal	9	2 –	75	1.	1635
	8	Oatmeal	17	7	66	2.	1800
	12	Rice	8		79	.4	1620
	11	Tapioca			88	.1	1650
		Starch			90		1675
		Flours					
	11	Entire wheat	14	2 –	72	1.	1650
	11	Graham	13	2 +	71	1.8	1645
	12	White (high)	11	1	75	.5	1635
	12	White (low)	14	2	71	.9	1640
	10	Macaroni	13	1 –	74	1.3	1645
		Bread, etc.					
	35	White	9	1	53	1.1	1200
	44	Brown	5	2 –	47	2.1	1040
	36	Graham	9	2 –	52	1.5	1195
	38	Whole wheat	10 –	1	50	1.3	1130
	36	Rye	9	1 –	53	1.5	1170
	20	Cake	6	9	63	1.5	1630
		Crackers					
	7	Cream	10	12	70	1.7	1925
	5	Oyster	11	11	71	2.9	1910
	6	Soda	10	9	73	2.1	1875
		Sugar, etc.			100		1750
		Molasses			70		1225
		Candy			96		1680
		Honey			81		1420
		Maple sirup			71		1250
		Starchy vegetables					
	13	Beans (dried)	23	2 –	60	3.5	1520
	70	Beans (baked)	7	3	20	2.1	555
	69	Beans (shelled)	7	1 –	22	1.7	540
7	83	Beans (string)	2		7	.7	170
	10	Peas (dried)	25	1	62	3.	1565
	75	Peas (shelled)	7	1 –	17	1.	440
	85	Peas (green)	4		10	1.1	235
	76	Corn (green)	3	1 –	20	.7	440
	76	Succotash	4	1	19	.9	425
20	63	Potatoes	2 –		15	.8	295
20	55	Potatoes (sweet)	1 +	1 –	22	.9	440
20	66	Parsnips	1 +		11	1.1	230
10	79	Onions	1 +		9	.5	190

CALORIES	*MM*	*CH*	*F*	*P*	VEGETABLE FOODS	*W*	*R*
Per pound	%	%	%	%	***Nuts***	%	%
1775	1.5	19	29	20–	Peanuts	7	25
1515	1.1	10–	30	12–	Almonds	3	45
1485	2.	3.5	34	9–	Brazil	3–	50
1430	1.1	6	31	8–	Filberts	2	52
730	.5	3	15–	7	Walnuts (black)	1	74
1250	.6	7–	27	7	Walnuts (English)	1	58
1145	.8	4	26	6	Hickory	1	62
1465	.7	6	33	5	Pecans	1	53
1295	.9	14	30	3	Coconuts	7	49
2865	1.3	32	57	6	Coconut (prepared)	4	
385	.4	1–	8	4	Butternuts	1	86
915	1.1	35	5–	5	Chestnuts	38	16
					Dried fruits		
1280	2.4	74		4	Figs	19	
1275	1.2	71	3–	2	Dates	14	10
1265	3.	69	3	2	Raisins	13	10
1185	2.	66	2	2	Apples	28	
1125	2.4	63	1	5–	Apricots	29	
					Fresh fruits		
295	.4	14	1	1	Grapes	58	25
260	.6	14		1–	Bananas	49	35
395	1.5	13			Plums	78	
230	.4	13		1–	Pears	76	10
220	.6	13–		1	Raspberries	86	
190		11			Apples	63	25
150	.4	9–		1–	Oranges	63	27
150	.6	7	1–	1	Strawberries	86	5
125	.4	6	1–	1–	Lemons	63	30
80		5			Muskmelons	45	50
50	.1	3–			Watermelons	38	59
					Green Vegetables		
185	1.2	7–		3.5	Mushrooms	88	
160	.9	8–		1+	Beets	70	20
155	1.1	7.5		1	Carrots	70	20
120	.6	6–		1	Turnips	63	30
100	.4	5–		1–	Squash	44	50
115	.9	5		1+	Cabbage	78	15
100	.5	4		1–	Tomatoes	94	
95	.6	4		1	Tomatoes (canned)	94	
95	2.1	3		2	Spinach	92	
65	.8	3–		1	Celery	76	20
65	.4	3–		1–	Cucumbers	81	15
65	.8	3–		1	Lettuce	81	15
60	.4	2			Rhubarb	57	40

Menus are the arranged meal-distribution of food. They are composed of groups of different foods. Menus should combine food palatably and so distribute it that it can be digested. Menus vary widely in type because adjusted to climate, season, food-supply and economic circumstances. But the general suggestions offered below are basal to all menus scientifically selected to meet food-needs.

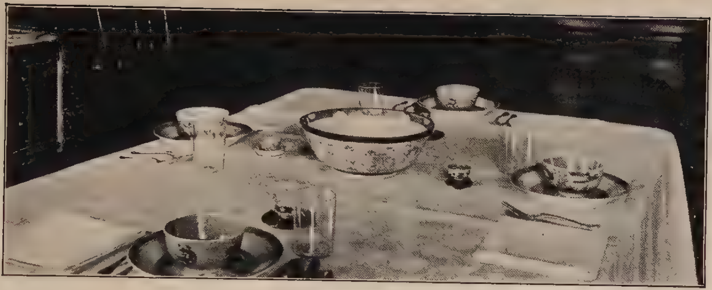
Dinner is both the most substantial and elaborate meal. What the dinner is determines what the other meals should be.

Daily Menus		Basic Suggestions
Breakfast (For Adults)	(For School Children)	(For Little Children)
Light — Fruit, buttered toast, coffee *Moderate* — Cereal, coffee, eggs, bread, fruit *Heavy* (for hard labor) — Cereal, coffee, meat, vegetable, bread, fruit	Milk, cereal, eggs, toast, fruit [Currently varied in kinds of foods used and methods of their preparation]	Cereal porridge; milk (*pure*), slightly cooked fresh eggs, oven toast or dry bread, fresh or freshly cooked ripe fruit (without skins or seeds)
Luncheon		
Summer — Thin soup, green vegetables, fruit salad, tea, hot bread or plain cake, fresh fruit *Winter* — Thick soup, starchy vegetables, egg-foods or sea-foods (Outdoor life) Cocoa, pancakes or tarts, fruit	No tea, no coffee, little uncooked or acid fruit, no highly seasoned food, no rich desserts Milk soups, cocoa, meat and eggs alternating, oil dressings, vegetables, bread, butter	No tea, no coffee, no fish, no pastry, no canned food, no extractive soups, no hot breads Baked custard, plain cold cake, jams only home-made. (Otherwise as for older children)
	Supper — Modification of luncheon	*Supper* — Like breakfast above

Dinner — (Manual laborers need dinner at noon and more food at all meals)

Summer — Fresh fruit or thin soup; poultry, roast, or steak; fresh green and starchy vegetables; light salad or frozen dessert; cream cheese and crackers; coffee. Cold bread with dinner.

Winter — Thick soup; bread; meat; starchy, green vegetables; substantial salad and light dessert or light salad and substantial dessert; coffee.



A DINNER-TABLE

A LUNCHEON-TABLE

A BREAKFAST-TABLE

Dietaries are the food-combinations selected to meet food-needs, as those of an individual or a family group. The foods composing a dietary are distributed into menus as meals.

Distribution of food through the day, week, month, year, as well as the kinds, combination, and quantity needed in different periods of life, at different work, and in varying health are all questions to be answered practically in forming dietaries.

Planned dietaries consider science-knowledge of food and body food-needs, but neither is fixed. Knowledge grows and needs change with altered conditions.

Quantities of food consumed should vary mainly with amount of work done, physical growth occurring and season, rather than be controlled by expense incurred, as is usual with those laboring hardest and longest.

Selection of Food-Combinations for Different Meals.

(At what meals and for which age should the following foods be served?)
Milk, pea soup, tomato bouillon, clam broth, oyster stew, bean purée.
Milk, tea, coffee, cocoa; oven toast, toast, dry bread, hot breads.
Beef, lamb, poultry, eggs; green vegetables, starchy; macaroni, rice.
Salads, light, substantial; sauces with oil, with vinegar.
Cake plain, cold, warm, rich; baked rice pudding, custard; pastry.
Gingerbread or sponge cake is palatable with apple sauce, blueberries, mountain cranberries. Name similar combinations.
Ice-cream and cake make a heavy dessert; fruit ices and lady-fingers a light; fruit gelatine or fruit soufflé or stewed fruit, a medium.
Use one of each of the desserts suggested and make with it a menu for a light dinner, for a moderate, for a heavy.
Make a menu for a light, moderate, heavy breakfast and luncheon with each of these dinner-menus.
Decide which you would like. Try to have such a meal. Is it palatable?

Write on the basis suggested, different menus of many types, choosing variety of foods from Tables on pp. 190–193.

The digestibility of a food depends upon the degree to which its nutrients (nourishing constituents) can be secured from it by the body when in health. Digestibility of foods determines therefore the nourishment they yield. Science finds that all food-constituents, even in the same food, are not equally digestible. In food in general 91% protein is digested, 95% fat, 98% carbohydrate.

DIGESTIBILITY OF NUTRIENTS OF DIFFERENT GROUPS OF FOODS

In Mixed Diet			%	In Foods Eaten Separately								
T	*V*	*A*		*Meat*	*Eggs*	*Milk*	*Cereals*	*Legumes*	*Vegetables*	*Fruits*	*Sugars*	*Starches*
92	84	97	Protein	97	97	97	85	78	83	85		
95	90	95	Fat	95	95	95	90	90	90	90		
97	97	98	CH			98	98	97	95	90	98	98

T, total; *V*, vegetable; *A*, animal food. Meat includes fish; milk includes butter. (After Atwater)

COMPARISON OF DIGESTIBILITY OF NUTRIENTS OF SPECIFIC FOODS

%	Bread White	Whole Wheat	Potatoes	Beans	Peas	Bananas
Protein	88	83	75	80	83	85
Fats	90			98		90
CH	98	95	99	97	95	90

(After Olsen)

Note different breads. Remember refuse and water are not included in nutrients of foods. The percentages given above are the usable proportion of the solid nourishing parts of foods.

TIME OF DIGESTION OF ANIMAL FOODS (After Thompson)

Eggs (raw) 1½ hr.
Eggs (cooked) 3½–5 hr.
Mutton (raw) 2 hr.
Pork (cooked) 3 hr.
Beef (raw or finely chopped) 2 hr.
Beef (rare) 2½ hr.; (well-done) 3 hr.
Beef (thoroughly roasted) 4 hr.
Veal (cooked) 2½ hr.

Some foods digest quickly and easily. Meats do. A food may digest relatively fully yet require much time and energy in digesting it. Cheese and beans do.

ORDER OF DIGESTIBILITY OF ANIMAL FOODS (Page 218)

Food Characteristics that affect digestibility of food are in general:

STRUCTURE of food (how food-constituents are held in food).

TEXTURE (fineness and compactness; coarseness and looseness). Fine-grained food understimulates the digestive tract. Coarse may render it overactive, resulting in elimination of food undigested.

PROPERTIES of food, as salts in milk and eggs, aid in keeping blood in condition for effective assimilation of food. Enzymes in food also aid digestion. Pineapple contains such an enzyme. It furthers the digestion of other foods. (Place a piece of meat between 2 slices of pineapple. Leave over-night. Examine next day.) Laxative foods contain substances that increase peristalsis.

PALATABILITY. Unappetizing food may decrease digestive juices.

Digestibility of food may be furthered by:

PREPARATION in cooking, that breaks up food, making it ready for digestion, and destroys bacteria that might disturb digestion or cause disease.

MASTICATION of food breaks it up and so exposes it to the digestive juices.

COMBINING foods so that digestive tract is used as a whole, as in mixed diet. Also supplementing foods deficient in any food-constituent with others containing this, *as rice (often lacking in salts) with egg-yolk, barley foods, and lentils that add such salts as those lost.*

QUANTITY adjusted to need. Too little or too concentrated food in lacking bulk may cause constipation. Too much or excess of bulky food stretches and weakens the stomach, clogs the body with waste products, and causes food-fermentation. With a moderate amount of food $\frac{1}{15}$ to $\frac{1}{14}$ more food is digested and is also more easily digested.

TIME and energy are both required to digest food. Different amounts of both are needed for different foods. Too rapid and too frequent eating as well as too much food weaken digestion. Adults usually need food 3 times daily at intervals of 4 to 5 hours.

FOOD as eaten excites the flow of digestive juices, especially acid, liquid, or sweet foods. Soups act thus at the beginning of a meal.

WATER, a glassful at the beginning of a substantial meal, increases flow of digestion juices and renders them more destructive to bacteria. (Hall)

ACIDS, fruits, or acid fluid food, as lemonade, in moderate quantity near *the end* of a meal, stimulate flow of gastric juice and increase the acid in it, so further digestion of food. (Hall)

Natural flavor of food is nature's indication of the food needed and even of the amount needed. Seasoning, the French say, would better be reduced to salting only than be a mixture of seasonings that conceal natural food-flavors.

Condiments that develop natural food-flavors are advisable. Some spices develop the flavors of each other and can be used together; some foods do this, as cabbage and squash together.

Seasoning should be incorporated in food as it is prepared, except where this will change unfavorably the constitution of foods. Salting string beans at the beginning of cooking toughens them. Salting meat before it is seared draws out the juices. Vanilla added to a hot mixture evaporates, because it itself vaporizes at relatively low temperature.

Excessive seasoning may be destructive of food itself as well as of its flavor. By hardening fiber, food is rendered less digestible, so less nutritious. By artificial heightening of flavor overstimulation of the digestive tract increases appetite for artificial food and more food than is needed. Excess of seasonings also introduces substances into the digestive tract that it cannot take care of in quantity. These may harden the tissues of its walls or cause overactive peristalsis.

As a child usually wishes to see sugar on a sweetened food, many adults desire to salt food. Though both salt and sugar are very necessary in a diet, in great excess they are harmful and may disorder digestion. It is important to cultivate a taste for well-seasoned food by eating it rather than becoming accustomed to flavorless food or excessive seasoning.

Dressings on food, as cream and salad dressings, containing egg and oil or milk and flour increase nourishment as well as palatability by uniting the food-ingredients and seasoning or flavoring the foods. Tart food-dressings stimulate peristalsis.

A MODERN DINING-ROOM

Palatability of food, that is, its agreeable effect, plays an important part in nutrition. But all food that is palatable is not necessarily wholesome. Such food-selection, preparation, service, are needed as will insure the fullest use of food in the body. Different persons like different foods. So long as variety is secured and convenience permits, such difference in taste should be respected, as this makes food more appetizing.

A meal as a whole, as well as separate foods, needs to be palatable. All foods are not equally agreeable together or even one after another during the same day. The diet as a whole, too, needs to be palatable. Overchanging diet overtaxes the body to adjust to unaccustomed foods. Monotony in diet has been thought to deaden appetite for even naturally preferred foods. Science finds, however, that the same diet if adjusted to the person's needs does not prove unpalatable. But as it is difficult so to adjust diet that a few kinds of food essentially contain exactly the constituents needed, variety is more apt to achieve this. It also enables one to change to different foods as environment or illness may require.

As seasoning may improve food-flavors, so the incidental accompaniments of a meal may enhance its palatability. Many of the foods too commonly eaten between meals can bring flavor into meals and should be so used. Such are candies, fruits, nuts. But many of these are themselves substantial foods, so must be used in small quantities or be served as a significant part of the meal with which they are eaten. Olives, for instance, when ripe, are a nutritious food; nuts are, too.

Refreshing rather than stimulating food is the need of the body. Green salads are refreshing and increase the palatability of diets that include them. Palatable food stimulates digestion by exciting an adequate flow of digestive juices.

Foods all have their seasons of finest flavor. All are altered by their preparation. Poor cooking makes all food poor. All food-effects are somewhat influenced by food-service and social surroundings. Superior quality of food, pleasant flavor, pleasing appearance as served, make food palatable.

Sustenance of the body is effected through the food eaten. The repair-food keeps the body alive, the fuel-food provides it with energy and body-heat.

The tissues of the body in performing their functions break down into waste products. This process is called *katabolism.* This is a chemical change, that is, a change in the composition of substances. All chemical change is accompanied by production of heat. Digestion of food is also a chemical change, so produces heat. Food elements are, through digestion, built up into body tissue. This is called *anabolism.* As life is lived this double process of breaking down and building up tissue goes on. Both together are called *metabolism.*

To build the body up as its living breaks it down, the food eaten must bring, in its heat value, the equivalent of the heat generated as the tissues break down. This is called maintaining the *metabolic equilibrium. Every 5 hours 422 calories are produced by adult living and must be supplied by food. Any work done requires further heat-energy.*

Well-nourished bodies produce the same quantity of heat per square unit of surface and so for the same size have the same heat-need. In the morning, fifteen hours after eating, the heat production of the body is least. A man at complete rest who weighs approximately *154 lb.* (*70 kg.*) produces in his process of just living *70 calories per hour* or 1680 calories in 24 hours. This is called the *basal heat-production.* If food is eaten for simple existence, the work done in eating is about 10% of this basal heat-production, or 7 calories per hour or 168 calories per day. *The existence requirement is therefore 1850 – calories per day* for an average-sized man *at rest.*

Exercise is necessary to life. This is work for the body and requires food fuel for the heat-energy needed.

Sedentary occupation and two hours' exercise increase man's daily food-need from 1850 calories to *2500 calories to maintain repair and provide nutriment and body-heat.*

(Specific facts on life-food are from Dr. Graham Lusk's "Fundamental Basis of Nutrition.")

The food-need of workers has been closely studied. It has been found that the amount of muscular effort exacted by different kinds of work requires differing quantities of food-energy.

For OCCUPATIONAL ENERGY-REQUIREMENT, see p. 222.

The quantity of energy-food (carbohydrates and fats) is the chief change work requires in diet. But in hard muscular labor a constant relatively high supply of building-food is necessary (protein, .25 lb. per day). This is not only for tissue-repair but also because protein facilitates utilization of all food eaten. The workers it is who need a liberal meat- and egg-supply.

Both sugar and fat can be digested in larger proportion by those at hard work than by others. The high heat of fat and the rapid heat-giving of sugar make these desirable work-foods. Those underfed in winter always consume sugar in abnormal quantity whenever it becomes available.

Starchy foods are work-foods of unique value, because starch gives sustaining energy — energy that lasts. As the amount of food of the work-diet should be large and the working body is active, food with little cellulose (woody fiber) is advisable. When it is present in large quantity it may hasten the food through the alimentary tract of those at hard work, before it has had time to be digested. Similarly the workers find white bread, not whole wheat, is the bread they should eat. Potatoes and rice have such fully available starch as to be most desirable work-foods. Their protein that is soluble also makes them valuable in work-diets.

Green vegetables and fruits are desirable in all diets and need to be obtainable by workers.

Much water and air in abundance are essential for the complete utilization of so much food as workers need. Time to masticate and digest food is a health-requirement for all that live.

Children differ from adults in more than size and strength. They are themselves still being physically formed. They are not simply growing larger but some parts of them are also being made. Teeth, for instance, develop after birth. In infancy the digestive agencies are not those of adult life. A child under nine months lacks ptyalin (a digestive ferment), which aids in digesting starch, so should not be fed starch. The child-body is more largely water than that of the adult. This is one reason why it has less resistance to infectious diseases. Proper nourishment increases physical resistance.

Development of unformed parts of the child-body, growth of all the body, need of learning to live and gradually to eat the foods usual for humanity, are some of the physical occupations of childhood. Exercise of muscle, sleep, mental work in exploring and understanding the environment, also affect the functioning of the body and its food-need as the child grows.

Effect of food is more immediate in childhood than it always is later. When undernourished, children are not well nor well-grown. Science finds child-health depends more upon food than was realized earlier. The food-habits formed are scarcely less important than the foods eaten. To make health for children they must be fed according to their need.

QUANTITIES OF FOOD FOR CHILDREN (WEIGHT AS PURCHASED)

		Amount Daily			
Child	2 yrs.	1 lb.	3 lb.	15–16 yrs.	Boy
Child	2–5 yrs.	1⅛ lb.	2⅜ lb.	15–16 yrs.	Girl
Child	6–9 yrs.	1⅜ lb.	2⅜ lb.	13–14 yrs.	Boy
Girl	10–12 yrs.	2 lb.	2⅛ lb.	13–14 yrs.	Girl
Boy	10–11 yrs.	2 lb.	2⅛ lb.	At 12 yrs.	Boy

With much outdoor life such as all children should have, these quantities may be increased. Exercise and air aid in full use of food by the body.

The kinds of food children are fed are most important because (1) children are not equally able at all ages to eat all foods (see below), (2) foods affect one another very differently (an excess of carbohydrates increases fermentation, so forms acids in the body. Acids dissolve mineral food-salts and carry from the body those needed for bone-growth and tissue), (3) food-constituents in different foods are not exactly alike (all proteins are not; vegetable proteins are less complete than animal; corn contains protein for repair-maintenance but not for growth; milk contains the growth-protein). Growth depends upon the growth-impulse in the living organism and an adequate supply of building- and growth-food.

Modern food-investigation has discovered that some foods have a growth-influence that usual building-foods lack. *Butter-fat and egg-yolk are such growth-foods.* No other fats, either animal or vegetable, are found to possess this special growth-power upon the body, so in this respect there cannot be an adequate substitute for butter, at least while the body is growing. It is therefore especially important that butter and eggs constantly be in the diet for all from infancy to maturity.

Science does not find that the growth-impulse becomes inactive save as it has had expression in growth. Yet it is not usual for those denied the conditions for growth in childhood and youth to enjoy these later.

FOOD-CONSTITUENTS OF NUTRIENTS OF CHILD-DIET (After Olsen)

AGE	*P*	*F*	*CH*	CALORIES		*CH*	*F*	*P*	AGE
1½ yrs.	43	35	100	910	1877	170	48	79	14–15 yrs.
2 yrs.	44	36	110	972	1737	245	47	72	11–13 yrs.
3 yrs.	50	38	120	1050	1270	150	44	60	8–9 yrs.
4 yrs.	53	42	135	1157	1224	145	43	56	5 yrs.

Grams are used as the unit of weight (1 oz. = 28.35 grams). Basis for table above was, in grams, *CH* 420 — *F* 100 — *P* 100, for adults.

Diet-experts differ somewhat in the standards they advise. See p. 223.

Heat value (calories) varies less for the different ages than food-weight. Compare these in tables. Note different proportions of food-constituents at different ages.

Nature always does much to sustain strength and to restore health after disease. Diet aids nature when it is such as can nourish the body during growth and in illness, but food that overtaxes a growing or diseased body by excess or wrong food hinders growth and return to health and may leave the body permanently weakened.

It is important the growing body be progressively fed but not more rapidly than it has the power to use foods new to it. Type of food-preparation needs to change too, from *liquid food to soft foods, then finely chopped and finally coarser,* dried food, compelling mastication.

Foods Needed Child-Age

Before 9 months — Milk. At 9 months — Milk, gruel (cereal), gelatin; water between meals.
1 yr. — Milk, gruel (cereal), broth (chicken or mutton).
1–1¼ yrs. — Add butter and ripe peach (skinned).
1¼–1½ yrs. — Add potato (baked), orange juice.
1½–2 yrs. — Add egg (soft).
2½ yrs. — Increase variety of similar foods (note below foods excluded).
2½–3½ yrs. — Add digestible, young, fresh vegetables, as peas, beans, squash, and, every 2 or 3 days, meat (as chicken, mutton chop, beefsteak, roast).
3½–5 yrs. — Eggs and meat on alternate days. Light dessert, as custard, tapioca, gelatin.
5–7 yrs. — Greater variety, but observe exclusions stated below.
7–11 yrs. — All foods permitted earlier, but more substantial diet. Few foods at a meal, but great variety in meals so as to form taste for all wholesome foods.
11–14 yrs. — Girls' and boys' food-needs begin to differ. Girls need ⅛ less food. Girls prefer more delicate and less highly-flavored foods. Girls tend to undereat. Boys often overeat meat; this may cause eczema. Diet should not be too largely animal food, though more is needed now. See page opposite.
14–16 yrs. — Food-needs of both boys and girls approach those of adult-life. Late eating at this age and stimulating foods and drinks will ruin the constitution. Regulation of life-processes now gives tone to the body, strength, and control for maturity.

(Adapted from "What Children Should Eat." — Greer)

Nature requires that food be so adjusted to the growing body that the diet not only supply the changing body-need as the body grows but also aid the body-processes. All foods not possible as yet for the growing body to digest must be withheld during growth. The food-restrictions in childhood are no less important than in disease, when nature necessitates the regaining of lost strength before the body can again be normally taxed by work and life.

Diet may affect directly health of teeth. It should contain starchy food stimulating mastication (as brown bread), and fresh fruit, as the apple, at the end of the meal. This exercises the mouth so that it frees itself of food, and leaves it fresh and physiologically clean. — Dr. Sims Wallace.

Diet-Exclusions During Childhood

Omit until after the Second Teeth

- Fat, except cream, butter, oil (as prescribed); other fats are less digestible (butter fat promotes growth).
- Acid foods (tomatoes, vinegar, pickled foods); acids remove from the body salts which promote bone-growth.
- Woody-fiber vegetables, as cucumbers, radishes, celery (raw); carrots permitted if digested.
- Fresh, warm breads. Preserved foods of all kinds. Bread not easily crumbed is not reached by the digestive juices.

Omit throughout Childhood

- Pies, pastry of all kinds, rich cake, rich nuts, gravies, dressings, and heavy foods.
- Sugar is needed but not in excess; candy (only simple and homemade).
- Coffee, tea, and all beverages except water, milk, cocoa. Coffee and tea stimulate but do not nourish; tea is constipating, so holds toxins of waste products in the body.

Food intoxication (see p. 207)

For children — The special diet indicated on page 207 is advised for two months after an attack, then 1 egg a day; two weeks later, milk with 4% fat; two weeks later, sugar cereals and cooked fruits slightly. In six months return to regular diet, but with little sweet food. If illness returns upon adding any food, exclude it (Backford). During such attacks plenty of air and little exercise are advised.

Mineral salts are a most definite growth-need. Lime aids skeleton-growth.

Illness is the result of the body's not working well in its living-processes. The cause may be (1) absence of conditions necessary for wholesome living, as lack of proper diet; (2) infection, as bacteria in food, air, water; (3) disordered organs resulting from work-strain or past disease; (4) weakness of physical constitution, as tendency to tuberculosis.

During illness the diseased condition usually needs to be combated by medical means, but the food and conditions of living must also be adjusted to the prevailing state of the body. What changes in food and living are required by the changed conditions of the body, the physician must determine.

Food during serious disease must be accurately adjusted to the exact physical need. Sometimes disease so changes the body that special types of foods are particularly unfavorable. Some disease so wastes the body that it needs especial building. Disease of all kinds affects digestion, so necessitates modification of diet and most intelligent care of food for invalids. Complete freshness and cleanliness of food, person, and surroundings, with habitual proper nutrition, avert disease and give physical resistance to infection.

Disease introduces poisonous substances into the body. The weakened body usually fails of power to remove these, or even those of the waste products of its natural living.

Water is therefore generally needed in increased quantity, and food, in most cases of acute illness, in decreased (also in liquid form unless the physician otherwise prescribes).

Strength must not, however, be lost through unnecessary lack of nutrition. Food-habits should be as little disturbed as the conditions of the illness permit.

Convalescence — the period of returning strength after illness — requires that food be plentiful but easily digested.

A TEA-TRAY

General diets for illness (see below) need careful adjustment for different individuals. A body incapacitated by illness usually needs foods it can easily digest. Some foods especially needed in illness often require special preparation to make them digest; milk may.

Liquid diet is usual in acute disease. It is advisable whenever a patient is in bed, and in the late afternoon for all not well. It consists of

Water, milk, whey, barley-water, gruel, beef-juice, broth, egg-white.

Light diet is used whenever substantial food is needed without exacting the exertion necessary to digest usual solid food. It consists of

Eggs (soft), milk toast, milk soups, broths (seasoned), beef (scraped), oysters, chicken, simple puddings (as soft custards, tapioca), jellies of gelatin, digestible fruits.

Convalescent diet is varied with the disease, so needs to be prescribed by the physician. Few and digestible foods need to be given, in small quantities but frequently. This consists of

Eggs, oysters, clams, meats (tender), fish (fresh), readily digested vegetables (as potato baked, rice), bread (well-baked), fruits (fresh and cooked), milk.

Laxative Foods (see p. 45) *Water in Illness* (see p. 206)

Diarrhea diet — Thoroughly cooked spinach, turnip greens, or mustard tops. One tablespoonful or more 4 times daily for 1–2 weeks, then with breakfast and luncheon for several weeks after return to regular diet. (Preferably no other food, but if any only little dry toast or corn bread.) Persons suffering from diarrhea are very sensitive to cold, even to cold food (Wilson).

Food intoxication — When food is not digesting (causing eruption, etc.)

Avoid — Sweets, fats, eggs, raw fruits (especially oranges), strawberries, rhubarb, tomatoes, salads, shell-fish, tea, coffee, pastry, gravies, butter, cream, cod-liver oil, eggs even in cooked foods.

Allow — Milk (skimmed), beef, mutton, fowl, fish in moderation, cereals, bread, and all vegetables not excluded above, cooked fruits, thick soups. (If cereal is sweetened, saccharin should be used instead of cane sugar.)

Digestibility of Foods (see p. 218)

Resistance to disease is secured by building a strong body, providing it with fresh, pure food properly adjusted to the age, sex, size, work of the person, and to climate and season, and by insuring an environment of such wholesomeness and cleanliness as will supply *to all* pure water and air and stamp out disease-sources, such as unsanitary disposal of garbage.

Preventive medicine removes disease-dangers from the environment and increases body-resistance. Conditions of living are of first importance. No body can be well nourished save as food is available. Protection against disease comes with provision for living. Illness is found to be social in its effects and causes. An ill person is a general health-menace.

A debilitating disease prevalent in the South, science says, requires, for elimination of it, nourishing food, sanitary disposal of sewage, and that children should wear shoes to prevent contagion from soil-contamination by waste products from those so diseased.

Natural immunity to disease-infection increases for children with age. The composition of the body changes; its water-content decreases. The excess of water in an infant's body lowers resistance to infection. To lessen this, milk may be decreased for a child after one year to the amount in adult-diet. Carbohydrate food increases the water in the body (Cernzy).

Constitutional inferiority opens a body to disease. Diet may minimize this. Secretions of the ductless glands of the body are now known to affect body-growth and health. Disturbed nutrition may cause defective development of these glands and in turn be caused by their resulting defective functioning. Mature health is thus endangered and work-endurance lessened.

Mineral salts effect nutrition as well as furnish material for teeth and bone-growth. A mixed diet provides food salts during adult-health, but not always in illness and childhood.

The growth-impulse can operate to mature the body only as the foods that will further growth and build tissue, both bone and muscle, are supplied for the use of the body in its growth. *The kind of food is therefore as vital a need as the amount*, particularly during the years of physical formation. Not only strength and health during growth but later too are effected by proper growth-diet.

Overrestriction of diet undernourishes the body, leaves it undeveloped and open to disease.
Maladjustment of diet produces malnutrition that causes malformation or malfunctioning of the body which may last throughout life.
Selection of proper food and thorough mastication result in nutrition.

During physical development all constitutions are delicate, so easily harmed. To grow physically and into mature health with high resistance to disease requires science-guided care in childhood and youth, also during disease.

An ice-bag applied to a child's head during fevers may make its body-temperature subnormal for life.
Reënforcing a delicate child's diet by feeding 1–2 T cream in mid-afternoon, as is desirable, may disorder digestion if rest is not enforced for 1–2 hours afterwards.

Adult-treatment of childhood and youth, like adult-diet, may not only do injury at the time but so weaken the constitution as to undermine later health.

Starving a child in illness may injure its intestines, while such treatment in adult-illness may be desirable. Sunshine, so important in plant-growth, is a powerful agency in tissue-building of children in need of much tissue-repair, as is a tuberculous child. But sun treatment (heliotherapy) for adults is not so assuredly advisable.

Exercise, as well as food, is necessary to growth and to bodily habits of health. But such competitive sports as may strain the heart, as can football, may injure growing boys.

The population of the United States of America is approaching 100,000,000. In 1910 those over 70 years numbered 2,270,021. There were about 2,500,000 births and about 1,350,000 deaths.

CAUSES OF DEATH U.S.A. — 1912

Accidents	182,000	Nervous diseases . . .	138,000
Tuberculosis	154,000	Pneumonia	132,000
Heart diseases . . .	150,000	Intestinal diseases . .	123,000

Numbers are approximate. (Hoffman's "Chances of Death and Ministry of Health")

Of those that died in 1912 about 18% (or 236,500) were under one year; 25% (or 329,400) were under 5 years. Only about one half of the deaths (57%) were therefore of those over 5 years. Yet it is in the combat of infectious diseases, which are the chief health dangers of the young, that science has made its greatest medical achievement. As science has succeeded in this it has increased the probable length of life for the young.

EXPECTATION OF LIFE NEW YORK LIFE-TABLE

1879–1881	AGE RANGE	1909–1911	GAIN	LOSS
41 yrs.	To 5 yrs.	52 yrs.	11 yrs.	
32.6 "	25–30 yrs.	34.3 "	1.7 "	
23.9 "	40–45 yrs.	23.4 "		6 mos.
	After 40 yrs. Constant loss			
	At 85 yrs.			3¼ yrs.

Before 40 yrs.	(women)	Life-Expectancy	29 yrs.	This is a *gain* from 1881–1911
" " "	(men)	" "	25 yrs.	and more than for men
After 40 yrs.	(women)	" "	18 yrs.	This is a *loss* from 1881–1911
" " "	(men)	" "	15 yrs.	and more than for men

Death after 50 years is due mainly to degenerative diseases, especially of heart and kidneys. Science ascribes this to strenuous life, lack of exercise in the open air, excess of nitrogenous food and spiritous liquids.

Old age brings a body that is gradually wearing out. This occurs naturally but is hastened by work- or anxiety-strains or earlier illnesses. Many body-processes become slower. Health in age requires increased oxygen-supply, simple diet and life, and exercise according to individual conditions.

Some body-organs lose power to function fully — the heart usually does; others may degenerate and lessen disease-resistance or cause illness. The kidneys act sluggishly and are unable to throw off so readily fluids and salts. Salt should be lessened in the diet. If the waste products of body-metabolism are not completely eliminated, they become poisons. The food-intake in age, especially of protein, should not be more than

P, 70 gms.; *F*, 140 gms.; *CH*, 90–160 gms. (Hirschfeld); that is, *P*, 2½ oz.; *F*, 4¾ + oz.; *CH*, 3–5 oz.

Body-deterioration usually includes hardening of the arteries. If extreme, less water is advisable, as dilation of inelastic vessels produces overstrain. When arteries harden, foods with lime are inadvisable. For Lime in Food, see p. 219.

Diseases of the respiratory tract are also a general danger in old age. (Scott's "The Road to Healthy Old Age.")

Human bodies, like animal, tend to increase fat with age. Excess fat interferes with body-processes and causes physical degeneration. Obesity is therefore to be avoided. Diet needs to be selected to prevent corpulency; less food is needed. Water taken with food increases body-fat; at noon not more than half a glass should be taken; at night none until 1½ hours after eating. The evening meal should be very light and without bread, preferably of only one food, either vegetable or fruit. Sleep should not follow eating immediately, for body-secretions are then inactive, so food fails to digest.

Youth is a period of significant physical development. Body-growth is being completed; the organs of the maturer functions of the body are developing; the body is maturing physically. The individual's mental powers are seeking more definite expression. The social relations of life are becoming more conscious. Life at this age is therefore full of newness and moves rapidly in its changes.

The growth-impulse of the body needs plentiful nourishment for free and full growth. Whether physical growth that is delayed by lack of nourishment can be effected after indefinite postponement is not yet known.

Ductless glands of the body play a more important part in its development and health than was realized earlier. The thymus gland delays too early development of the later body-functions. The thyroid gland promotes the differentiation of developing organs. Intricate interrelations are found to exist between all such glands. Their wholesome functioning is of greatest importance to growth and mature health. Healthful youth furthers this. Disturbing illness prevents normal development and functioning of these glands.

Food that is strengthening and sustaining rather than stimulating is the need of youth. Such specific growth foods as egg-yolk and butter-fat should be abundant in youth-diet. Mineral salts too are particularly needed. Excess of food and starvation alike remove these from the body. The body at this time is not very resistant to disease. In fevers the nitrogen-waste is extreme. Science now finds this lessened by feeding carbohydrates in abundance. This must, however, be under a physician's direction. Both scientists and physicians are now interested in diet as never before.

See Sensible Diet, p. 213; Diet-Quantities, p. 219.

Adult-life is the time of greatest responsible effort. Health is basal to energy. It is secured for the well-developed body by scientific regulation of diet and of habits of life and work.

Adult-diet is more affected by occupation than that at other periods. Lighter work needs both less food and lighter.

Habitual diet often seems to satisfy the needs of the body more fully than science would anticipate. The Japanese that are accustomed to a small protein intake seem to flourish upon it. Scientific experiment shows that in adult-life less protein than is commonly eaten is advisable. A very small amount (20 gms. or 1— oz. daily) has been found adequate to sustain life and light work. Though great reduction of protein is not generally advised, a decreased intake should be tried. Adult-life is the safe period for scientific experimentation with diet.

Sensible diet — To keep warm and give energy for work, Dr. E. L. Fish advises eating energy or fuel foods — potatoes, bread, cereals, corn-bread, sirup, and other sugars. To keep muscles and organs in repair, eat a limited and fixed amount of repair foods — meat, eggs, cheese, nuts, flesh foods, peas, beans, and lentils. Do not increase the repair foods with increase in work or exposure to cold; increase the fuel-foods.

Eat fruit every day. Canned fruits are good. Cooked fruit is often better than dubious fresh fruit, but some fresh fruit is essential. Eat fresh, green vegetables whenever you can get them. Thoroughly wash all raw foods. Eat some bulky vegetables of low food-value, like carrots, parsnips, spinach, turnips, squash, and cabbage to stimulate the bowels and give flavor to the diet and prevent overnourishment. Eat slowly and taste your food well and it will slide down at the proper time. Do not nibble your food timorously; eat it boldly and confidently. A glass or two of water at meals is not harmful if you do not wash your food down with it. An unsocial dinner table will upset all the food-values.

First, last, and all the time, be moderate; avoid overnourishment and overweight. Restrict fuel foods and burn up body-fat if tending toward obesity. See Fatigue, p. 216; Body as a Chemical Laboratory, p. 216; Diet Quantities, p. 219.

Many foods no longer considered foreign because so usual in the home market are produced only in other lands, as cocoa, tea, coffee. Food-sources and food-exchange disclose such facts about the origin of foods. Food luxuries and delicacies, as spices and tropical fruits, have long been transported as nations have grown in wealth. But only with extended commerce have imports and exports of substantial foods, as beef from Argentina, become significant food-trade practices.

And only with migration of workers from land to land are the staple, fundamental articles of diet of different peoples disseminated. The foods and methods of preparation are brought by the immigrating people and are gradually absorbed by those among whom they come to live.

The population of America is composed of the greatest variety of peoples. See p. 185. Only half is native-born of native parentage; the other half is from all nations.

Foreign-born residents number about one tenth and are distributed as follows:

German	2,501,000	English	900,000
Austro-Hungarian . .	1,671,000	Scotch and Welsh . .	500,000
Russian	1,602,000	Belgian and Dutch . .	170,000
Irish	1,352,000	Orientals	146,863
Italian	1,343,000	French	117,000
Scandinavian-Danish .	1,250,000		

The native foods of such a population include most of those known to present-day civilization.

The varieties, qualities, and preparations of cheese, rice, breads, starchy-vegetable foods (as macaroni, semolina, polenta), of green vegetables (as spinach, Swiss chard) and salads (as chicory, romaine, escarole), and of diet-accessories (as olives, olive oil), are relatively recent as American foods.

For the masses in all lands the usual diet is still mainly of foods locally and inexpensively produced. Transported or expensive foods become available only with increasing prosperity. Consumption of these is therefore an index of this.

Meat, the most costly of common foods, has become more widespread in its use, though the amount eaten is somewhat controlled by climate, and its use by individuals is decreased where diet is directed by science. By workers as a class it is needed in larger quantity than by others, whose building food may come somewhat more largely from other protein foods.

Scientific investigation is showing the food-consumption of different nations.

MEAT-CONSUMPTION (PER CAPITA ANNUALLY) 1910–1913

Australia	250 lb.	Belgium and Holland	75 lb.	Spain	49 lb.
United States	130 "	France	74 "	Russia	48 "
Germany	115 "	Austria-Hungary	64 "	Italy	23 "
England	105 "				

In Germany over three times as much meat is now eaten as a century ago; then it was little more than in Italy now.

GERMAN MEAT-CONSUMPTION 1816–1907

Munich Augsburg Nuremberg	80.2 kilos	Berlin Karlsruhe Mannheim	79.9 kilos	Königsberg	40.7 kilos

MEAT CONSUMED BY WORKERS AND OTHERS (PER CAPITA YEARLY)

Artisans	44.8 kilos	Middle class		Higher class	12 kilos
Laborers (farm and day)	16.5 "	Lower	15 kilos	[kilo = 2.2 lb.]	
		Upper	10.5 "		

(All data from Professor Max Rubner's "Changes in the Food of the Masses.")

Similar studies for other nations have not been made so complete as this on meat-consumption.

Fatigue. Work performed by any one of the body-cells produces waste products and other changes in the cells. Up to a certain limit, work, with the resulting changes in the cells, is beneficial and improves the physical condition of the cells, but when the work is excessive, too prolonged, or too fast, waste products begin to accumulate, the cells become exhausted, the proper changes fail, and if the cells are not properly rested, damage results. If the work is continued without proper rest, early breaking down and failure of the individual to perform his task are the final results. — B. S. WARREN in *Public-Health Report.*

Rest in its effect upon the body has been experimentally studied by science. At the end of a week of monotonous work the reactions of the body are distinctly more sluggish than at the beginning, after a day of change. The sensitiveness and elasticity of the body as well as its energy are thus revived. One day of rest in seven science considers needed for preservation of body-elasticity and recuperative power. Recreation, not inactivity, is the body's weekly rest-need. The body that does not change its activity not only loses its power to change but also wears out soon.

Further study is being made of different daily activities to ascertain the hours of work propitious for health; also to what kinds of recreation the body makes the fullest wholesome response.

It has long been known that eight to nine hours of sleep are required daily to give the adult body healthful activity in its living-processes.

The body is a great chemical laboratory which is constantly dealing with a variety of chemical compounds, and the processes are of a complex and unique nature. . . . The proteins, the carbohydrates, fats, etc. have to undergo many changes in the course of their amalgamation with the tissues of the body. They are ultimately subjected to regressive (disintegrating) processes and are eliminated from the body in the form of relatively simple compounds, such as carbonic acid, urea, and uric acid. This long series of physiologic changes, with the intermediate products, is at present only known to us in part. . . . This chain of events may result in the production not only of useful and indifferent substances but also of injurious and toxic bodies; while any check to the normal processes of elimination may lead to an accumulation in the system of normal waste products and a consequent intoxication (poisoning). — ALLAN MACFADYEN in *Clinical Journal.*

Humankind digests its food with less expenditure of energy than do animals. It therefore has more energy for other uses. Human beings can do more work and endure more fatigue, also exposure, than any other living creature of similar size because less taxed and occupied with digestion. The human digestive tract is prepared to utilize, not only with relative ease but also relative completeness, edible plant and animal foods.

Though body-constituents and food-constituents are the same, food cannot without change be used by the body. Digestion is the body-process of changing food into the forms necessary for body-utilization. *Food to be digested must be made soluble in the body so it can pass through the wall of the blood-vessels into the blood-stream that carries it throughout the body.*

Of the five food-constituents two only, mineral salts and water, pass into the blood unchanged. Proteins, carbohydrates, fats, must be changed by the digestive juices and ferments before they can be utilized by the body.

Digestion, the process that produces these food-changes, is effected through the operations of the digestive tract. Though there is more consciousness of food when it is in the mouth than elsewhere there is less happening to it then than later. As it passes down the alimentary tract the digestive activity increases. Food is retained in the mouth only a very short time even when thoroughly masticated, whereas it remains in the stomach from 2 to 5 hours and usually takes about 2 days to travel the entire length of the intestine (12 hours in the small intestine and 36 hours in the large).

Food is eaten at intervals of 4 to 5 hours during the day, and food-waste should be removed from the body once in 24 hours, preferably in the morning after breakfast.

The senses of smell and taste, Dr. W. Sternberg insists, recognize chemical changes in food more sensitively than these can be detected with chemical tests. In warmed-over dishes, especially vegetables, some chemical change has occurred. This change renders them less wholesome, he states, for the person that finds them less palatable. Continued loss of appetite leads to some disease of dietary deficiency that is even less easily remedied than diseases caused by overeating, serious as these are. The science of cookery is, he concludes, far more than applied chemistry, physics, and application of heat. It includes applied physiology of the senses, applied æsthetics, and applied psychology, he says, and is a matter of taste in the widest sense of the term.

Digestibility of foods, though differing somewhat for individuals, has been determined in general by artificial digestion (their solubility in chemically produced digestive juices) and experimental digestion (their utilization by the body tested by comparison of food-intake and waste-outgo). The tabulated results are suggestive in selecting dietaries.

Digestibility of Nutrients of Different Groups of Foods and Comparison of Specific Foods, p. 196; *Food-Characteristics as Aids to Digestibility*, p. 197; *Digestibility of Fruits*, p. 44; *Time of Digestion of Eggs*, p. 109; *of Animal Foods*, p. 196.

Order of Digestibility of Animal Foods (After Thompson)

Oysters, eggs (raw or soft-boiled), sweetbreads;
Whitefish (boiled or broiled), as bluefish, shad, weakfish, smelts;
Chicken (boiled or broiled), roast beef (lean), eggs (scrambled or omelet);
Mutton (roasted or boiled), squab, partridge, bacon (crisp);
Fowl (roasted), capon, turkey (boiled); tripe, brains, liver;
Lamb (roasted), chops (mutton or lamb), corned beef, veal;
Ham, duck, snipe, venison, rabbit, game;
Salmon, mackerel, herring, goose (roasted);
Lobster, crabs, pork; smoked, dried, pickled fish or meats.

The meats that digest less readily increase the danger of gastro-intestinal disturbance. Delicate, tender meats (porterhouse steak, beef roast, lamb chops, chicken-breast, bird) digest more readily than other meats *for persons of imperfect digestion*. In skin inflammations, high blood-pressure (due to hardened arteries), rheumatism, and thyroid hypersecretion meat is inadvisable. Meat as it is eaten produces heat in excess of its energy value. It is therefore lessened in summer diet.

Construction of the body (growth), its integrity (health), its regeneration (repair), depend upon food-utilization. If the body cannot use the food eaten it is not nourished. (Food-quantities, pp. 222–223.)

Food-proteins are made up of about twenty simpler compounds (amino-acids). All these are not in every food-protein. The food-proteins that contain the compounds that body-protein is made up from are called "complete" proteins (milk, egg-white, meat); others, incomplete (wheat, corn, gelatin). "Complete" proteins maintain the body and promote growth. Of the incomplete, wheat-protein maintains the adult body but does not further growth. Corn-protein alone can do neither. Milk adds what it lacks. It is not nutritively significant whether protein is animal or vegetable, but whether it contains what is needed for body-protein. "A low intake of suitable protein may be infinitely more advantageous to nutrition than a surfeit of an 'incomplete' protein." (Mendel.)

Food-fats differ in body-use. Butter-fat, egg-fat, cod-liver-oil fat further growth. Lard, olive-oil, cottonseed-oil do not promote growth.

Food-carbohydrates and fats are used by living body-cells in increased quantity when present in large amounts, hence obesity from overeating.

Food-salts differ in foods, also in body-function. If calcium is absent from the blood excessive nerve-irritability results. Food-salts are imperatively needed for body-structure and regulation of body-function. (Children need lime in food for bone-growth. The aged need food with little lime because it hardens arteries.)

LIME IN FOODS (From Aron's Table)

	%		%		%		%
Cheese	1.35	Milk	.151	Dates	.08	Bread	.03
Butter	.35	Beans	.145	Rice	.078	Egg-white	.02
Spinach	.196	Peas	.12	Cabbage	.06	Potatoes	.02
Egg-yolk	.19	Cocoa	.115	Oranges	.06	Meat	.006

Too much fat or carbohydrate in food, too much food, or too little, or excess of carbon dioxid causes loss from the body of such food-salts (alkalies). Such loss produces acid-intoxication.

Note: Meat, egg-white, grains, bread, potatoes, lack lime.

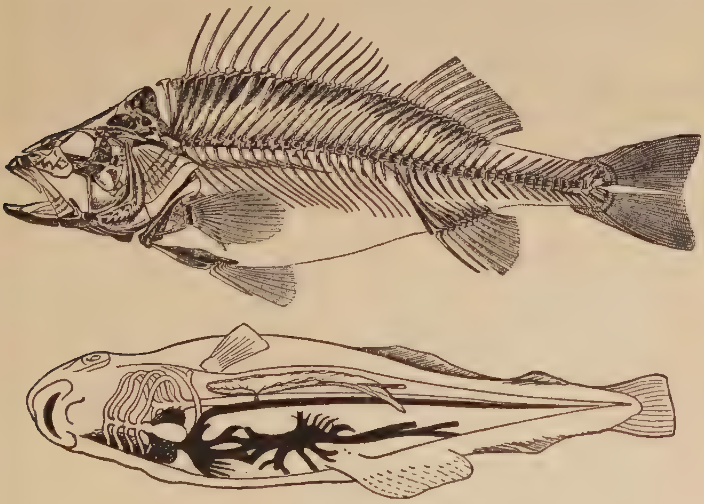
The operations of the body are delicate in their mechanism and the body most sensitive to minute quantities of many substances. (Epinephrin is present in $\frac{1}{100000000}$ part in blood but is necessary to life.)

Preservation of Eggs by Refrigeration in Sterile Air. Lescardé at the Third International Congress of Refrigeration described a method of preserving eggs by refrigeration in sterile air. The eggs are placed on end in horizontal fillers made of pasteboard and wood; then these fillers are put into tin cases which can be hermetically sealed, each case having a capacity of six fillers containing 160 eggs. The covers of the filled cases are then soldered, and the cases are deposited in an autoclave (digester) which contains twelve cases of 960 eggs each. A vacuum is then made in the autoclave, and a duly proportioned mixture of two gases, carbon dioxid and nitrogen, is injected. This process is very simple, because carbon dioxid and nitrogen, in the form of compressed or liquefied gases, are on the market now, so that the manipulation of a few cocks and the reading of a gauge suffice to produce the proper mixture. The process in the autoclave having been completed, the cases are taken out, hermetically sealed, and stored in cold-storage rooms, at a temperature varying from 1 to 2° C. The chief advantages accruing from the preservation of eggs in sterile air are the following: (1) Waste, of such importance in ordinary cold storage, is completely eliminated. (2) The eggs retain a perfectly "fresh" flavor, and consequently they remain excellent for table use even after ten months' storage; they also retain their full weight, because no evaporation is possible in the tin cases. (3) After their removal from the cold-storage rooms the eggs remain in perfect condition for a long time and can be shipped long distances without deterioration; this constitutes a signal superiority over the ordinary cold-storage eggs, which deteriorate rapidly after having been taken out of cold storage. The reason for this is simple: the antiseptic air which surrounds them for several months, together with the cold, absolutely destroy all bacteria which may be on the shell of the egg or in its substance. Deterioration cannot set in except by re-infection, which is produced only by exposure to the air for several weeks. By reason of the above-mentioned advantages, eggs preserved in sterile air find a ready market and command much higher prices in winter than ordinary cold-storage eggs, or even the so-called "fresh" imported eggs. The cost of treatment and preservation amount to 15 francs per thousand.

(Quoted from *The Journal of the American Medical Association*)

Shipping Live Fish in the Frozen State. In the markets of Irkutsk, Siberia, fish are displayed for sale in the frozen state piled up like cordwood. Fish in cold storage are preserved frozen in slabs of ice. The latter method is now applied in the shipment of live fish. The method of shipping live fish in water is not feasible on account of the expense. Pictet discovered that fish may be frozen in blocks of ice without being killed, and that they will become as lively as ever after they are thawed out. The fish in a large amount of water are placed in a closed tank, and oxygen under pressure is supplied. The greater portion of the water is then drawn off. The fish remain in good condition on account of the abundant supply of oxygen. The vessel containing the fish is then placed in a freezing tank and the fish are frozen into the ice formed. The blocks of ice containing the fish can then be piled up in the ordinary refrigerator car. On arrival at their destination the fish are put through a slow thawing process lasting ten hours, when they return to their normal state of active animation.

(Quoted from *The Journal of the American Medical Association*, December 27, 1913)

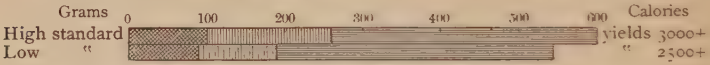


Perch — Skeleton and Circulation

Food-quantity was the first consideration of Diet-Science when it began the study of Human Nutrition. The food-amounts sanctioned as dietary standards have been greatly modified of late, due to more comprehensive experimentation and searching investigation.

The variation in food-habits, as shown by investigation-records, and in nutritive possibilities, as tested by experiment, is very wide. Yet there are diet-limits that it is not physiologically advisable to overstep, if indeed safe. These are flexible, because they change with climate, occupation, diet-habit, size, sex, age, health. Diet-standards have value as a basis for selecting the dietary. For Food-Variety, see p. 224.

DIET CHART (For man at moderate work) DAILY FOOD-NEED



The lower standard is the more recent recommendation of diet-scientists.

Dry nutrients — *P* 3 oz. — *F* 3½ oz. — *CH* 10½ oz. (low)
P 3½ oz. — *F* 3½ oz. — *CH* 14½ oz. (high)

▨ Protein
▥ Fat
▤ Carbohydrate

Food-weight of food as purchased is 3–4 lb. per capita per day.

Food-Amounts according to Age, p. 182; *Old-Age Requirement*, p. 211; *Food-Need of Childhood*, pp. 203–205; *Food-Utilization and Digestibility of Foods*, pp. 218–219.

Metabolism (the process of actively breaking down and building up body-tissue) is increased in childhood and decreased in age. The protein-need changes during growth and old age, but not with work.

OCCUPATIONAL ENERGY-REQUIREMENT

MEN	CALORIES PER DAY		WOMEN
Tailor	2600–2800	2000	Seamstress (hand)
Bookbinder	3000	2100–2300	Seamstress (machine)
Shoemaker	3100	2100–2300	Bookbinder
Metal-worker	3400–3500	2500–3200	Housemaid
Painter	3500–3600	2900–3700	Washerwoman
Cabinet-maker	3500–3600		
Stone-cutter	4700–5200		
Wood-cutter	5500–6000		

(From Report of *Journal of the American Medical Association* on Respiration Experiments of Physiological Institute at University of Helsingfors, in Finland. The carbon-dioxid output of these persons was scientifically determined during *rest* and during *work*. With this as a basis the energy needed to live and to work for 8 hours a day was calculated.)

Selection of Dietary — Choose foods preferred by those to be fed. Introduce new foods periodically; discontinue if digestion is disturbed.

Note especially protein-foods that seem digestible. Use these. Combine with "incomplete" proteins some "complete," p. 219.

Consider digestibility (p. 218) of all foods used; also ease of digestion.

Use together foods of rapid and slow utilization, as sugar and starch.

Combine Building — Energy — Digestion Foods, pp. 172–174.

Acid-excess is undesirable in the body. To prevent this, use base-producers (potatoes, apples, raisins, cantaloupes) with acid-producers (meats, cereals, prunes).

Approximate the general menus on pp. 194–195. Use foods in season. Prepare food freshly.

It is not advisable to attempt to calculate the amount of food as it is used daily. The sources of error are so many that the total inaccuracy exceeds that of a larger more general calculation, such as is suggested.

Calculation of Dietary — To estimate food-quantity for a family: Record all staple foods on hand at the beginning and end of a week. Add to the difference the foods purchased during the week, if used.

Subtract 10% (waste in raw material and through preparation). Divide remainder by number of those fed (using proportions on p. 182).

This gives food-bulk consumed per capita per week. For succeeding week adjust to standard if not in accord.

Note weights of each food used. Calculate P — F — CH in amount of each used. (Food-Tables, pp. 190–193.) Add these for all foods eaten.

Compare proportions of these totals with standard. If necessary, change foods to secure similar relation.

This gives standard diet-balance of food-constituents.

Multiply total $P + CH$ (in oz.) by 125 and F by 250. The sum of these is a close approximation of the calories of the food eaten.

This may be obtained by adding calories given in Food-Tables, but to do so makes the calculation more cumbersome.

This gives the Fuel Value or Heat-Energy of the dietary. Distribution by proportions (p. 182) gives calories per person.

Estimate cost of the adjusted dietary per family per year. Compare with Income-Distribution, p. 183. Food-Cost, p. 156.

This gives food-expense as economic factor of income.

Food-variety has long been considered a health-necessity. Diet can be more limited in variety if it is accurately adjusted to the individual food-need. Foods of different kinds are never fully interchangeable in the diet. As foods differ even in their most minute constituents, so do they in nutritive effect. *Hence the necessity of considering the kinds of food and the palatability as well as the quantity.*

Science finds that peoples in extremes of climate, which restrict the food-supply, live upon very limited food-combinations; also that those of curtailed resources eat only a few food-combinations of simple foods. Some of the latter foods of foreign origin have recently been introduced into American diet.

Diet-expansion has been directly effected by these foods that have come with the peoples long accustomed to their use in other lands. The food-preparations so brought are often unique. They are the age-long experience resulting from the effort to make palatable, nutritious diet from limited food-resources. Such are inexpensive foods, because this has been the need of the workers whose resources are least and food-needs greatest of any social group. What experience has taught them can be learned from them, though their food-needs exceed their present diet-possibilities.

Hygeia

OLD CHINESE DISHES

INDEX

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175